9-Output 1.5V PCIe Gen1-2-3 Fanout Buffer with Zo=100ohms

9DBU0941

DATASHEET

Description

The 9DBU0941 is a member of IDT's 1.5V Ultra-Low-Power (ULP) PCIe family. It has integrated terminations for direct connection to 100Ω transmission lines. The device has 9 output enables for clock management, and 3 selectable SMBus addresses.

Recommended Application

1.5V PCIe Gen1-2-3 Fanout Buffer (FOB)

Output Features

- 9 1–167MHz Low-Power (LP) HCSL DIF pairs with Zo=100Ω

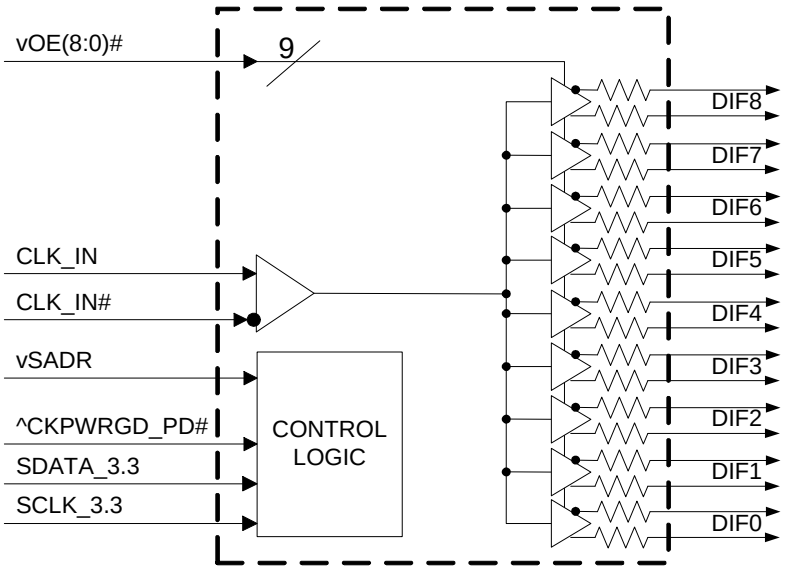
Key Specifications

- DIF *additive* cycle-to-cycle jitter < 5ps
- DIF output-to-output skew < 60ps
- DIF *additive* phase jitter is < 300fs rms for PCIe Gen3
- DIF *additive* phase jitter < 350s rms for SGMII

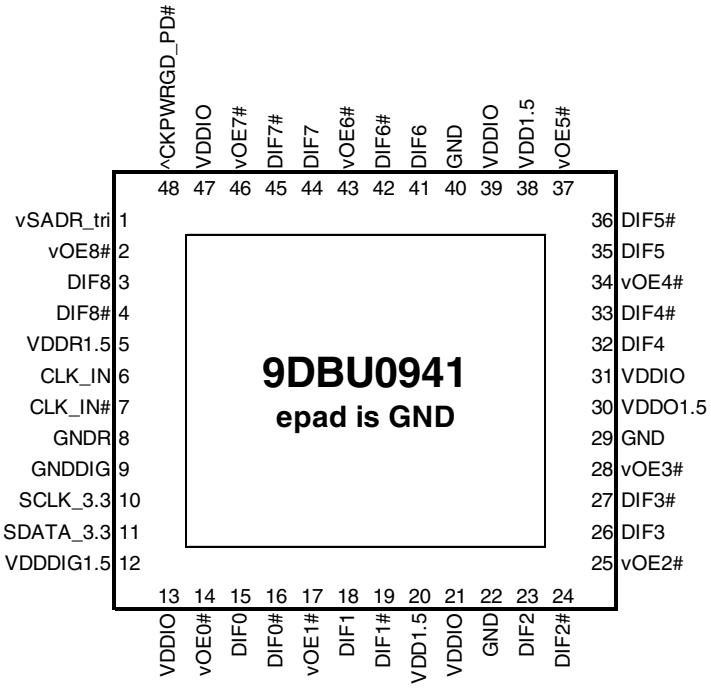
Features/Benefits

- Direct connection to 100Ω transmission lines; save 36 resistors compared to standard HCSL outputs
- 47mW typical power consumption; eliminates thermal concerns
- Outputs can optionally be supplied from any voltage between 1.05 and 1.5V; maximum power savings
- Spread Spectrum (SS) compatible; allows SS for EMI reduction
- OE# pins for each output; support DIF power management
- HCSL-compatible differential input; can be driven by common clock sources
- SMBus-selectable features; optimize signal integrity to application
  - slew rate for each output
  - differential output amplitude
- Device contains default configuration; SMBus interface not required for device operation
- Selectable SMBus addresses; multiple devices can easily share an SMBus segment
- 3.3V tolerant SMBus interface works with legacy controllers
- 6 × 6 mm 48-VFQFPN; minimal board space

Block Diagram



Pin Configuration



48-pin VFQFPN, 6x6 mm, 0.4mm pitch

^v prefix indicates internal 120KOhm pull up *AND pull* down resistor (biased to VDD/2)

v prefix indicates internal 120KOhm pull down resistor

^ prefix indicates internal 120KOhm pull up resistor

SMBus Address Selection Table

	SADR	Address	+ Read/Write bit
State of SADR on first application of CKPWRGD_PD#	0	1101011	x
	M	1101100	x
	1	1101101	x

Power Management Table

CKPWRGD_PD#	CLK_IN	SMBus OEx bit	OEx# Pin	DIFx	
				True O/P	Comp. O/P
0	X	X	X	Low	Low
1	Running	0	X	Low	Low
1	Running	1	0	Running	Running
1	Running	1	1	Low	Low

Power Connections

Pin Number			Description
VDD	VDDIO	GND	
5		8	Input receiver analog
12		9	Digital power
20,30,31,38	13,21,31,39,47	22,29,40	DIF outputs

Note: EPAD on this device is not electrically connected to the die. It should be connected to ground for best thermal performance.

Pin Descriptions

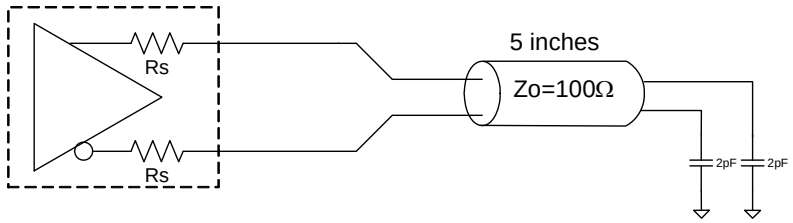
PIN #	PIN NAME	TYPE	DESCRIPTION
1	vSADR_tri	LATCHED IN	Tri-level latch to select SMBus Address. It has an internal 120kohm pull down resistor. See SMBus Address Selection Table.
2	vOE8#	IN	Active low input for enabling output 8. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
3	DIF8	OUT	Differential true clock output.
4	DIF8#	OUT	Differential complementary clock output.
5	VDDR1.5	PWR	1.5V power for differential input clock (receiver). This VDD should be treated as an Analog power rail and filtered appropriately.
6	CLK_IN	IN	True input for differential reference clock.
7	CLK_IN#	IN	Complementary input for differential reference clock.
8	GNDR	GND	Analog ground pin for the differential input (receiver)
9	GNDDIG	GND	Ground pin for digital circuitry.
10	SCLK_3.3	IN	Clock pin of SMBus circuitry, 3.3V tolerant.
11	SDATA_3.3	I/O	Data pin for SMBus circuitry, 3.3V tolerant.
12	VDDDIG1.5	PWR	1.5V digital power (dirty power)
13	VDDIO	PWR	Power supply for differential outputs
14	vOE0#	IN	Active low input for enabling output 0. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
15	DIF0	OUT	Differential true clock output.
16	DIF0#	OUT	Differential complementary clock output.
17	vOE1#	IN	Active low input for enabling output 1. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
18	DIF1	OUT	Differential true clock output.
19	DIF1#	OUT	Differential complementary clock output.
20	VDD1.5	PWR	Power supply, nominally 1.5V
21	VDDIO	PWR	Power supply for differential outputs
22	GND	GND	Ground pin.
23	DIF2	OUT	Differential true clock output.
24	DIF2#	OUT	Differential complementary clock output.
25	vOE2#	IN	Active low input for enabling output 2. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
26	DIF3	OUT	Differential true clock output.
27	DIF3#	OUT	Differential complementary clock output.
28	vOE3#	IN	Active low input for enabling output 3. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
29	GND	GND	Ground pin.
30	VDDO1.5	PWR	Power supply for outputs, nominally 1.5V.
31	VDDIO	PWR	Power supply for differential outputs
32	DIF4	OUT	Differential true clock output.
33	DIF4#	OUT	Differential complementary clock output.
34	vOE4#	IN	Active low input for enabling output 4. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
35	DIF5	OUT	Differential true clock output.
36	DIF5#	OUT	Differential complementary clock output.
37	vOE5#	IN	Active low input for enabling output 5. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
38	VDD1.5	PWR	Power supply, nominally 1.5V
39	VDDIO	PWR	Power supply for differential outputs
40	GND	GND	Ground pin.

Pin Descriptions (cont.)

PIN #	PIN NAME	TYPE	DESCRIPTION
41	DIF6	OUT	Differential true clock output.
42	DIF6#	OUT	Differential complementary clock output.
43	vOE6#	IN	Active low input for enabling output 6. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
44	DIF7	OUT	Differential true clock output.
45	DIF7#	OUT	Differential complementary clock output.
46	vOE7#	IN	Active low input for enabling output 7. This pin has an internal 120kohm pull-down. 1 = disable outputs, 0 = enable outputs.
47	VDDIO	PWR	Power supply for differential outputs
48	^CKPWRGD_PD#	IN	Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode. This pin has internal 120kohm pull-up resistor.
49	EPAD	GND	Connect EPAD to ground.

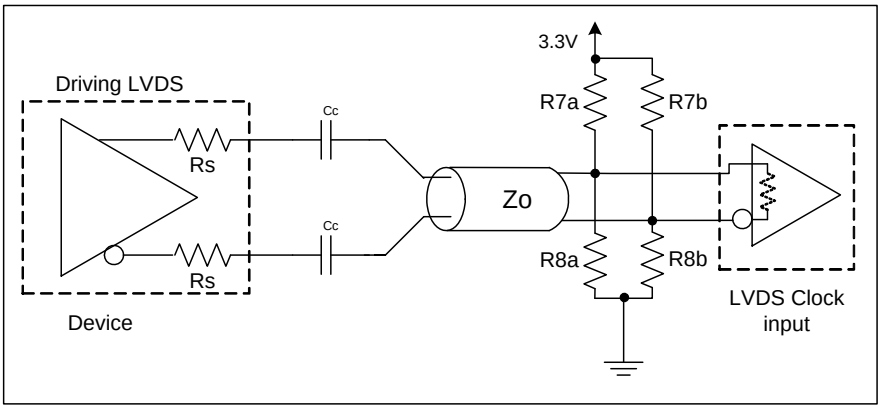
Test Loads

Low-Power HCSL Differential Output Test Load



Note: The device can drive transmission line lengths greater than those allowed by the PCIe SIG

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	0.1µF	0.1µF	
Vcm	1.2 volts	1.2 volts	

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the 9DBU0941. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Supply Voltage	VDDx	Applies to VDD, VDDA and VDDIO	-0.5		2	V	1,2
Input Voltage	V_{IN}		-0.5		V_{DD}+0.5	V	1,
Input High Voltage, SMBus	V_{IHSMB}	SMBus clock and data pins			3.3	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 2.0V.

Electrical Characteristics–Clock Input Parameters

TA = TAMB, Supply voltages per normal operation conditions; see Test Loads for loading conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Input Common Mode Voltage - DIF_IN	V_{COM}	Common Mode Input Voltage	200		725	mV	1
Input Swing - DIF_IN	V_{SWING}	Differential value	300		1450	mV	1
Input Slew Rate - DIF_IN	dv/dt	Measured differentially	0.4		8	V/ns	1,2
Input Leakage Current	I_{IN}	$V_{IN} = V_{DD}$, V_{IN} = GND	-5		5	µA	
Input Duty Cycle	d_{tin}	Measurement from differential waveform	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–Input/Supply/Common Parameters–Normal Operating Conditions

TA = TAMB, Supply voltages per normal operation conditions; see Test Loads for loading conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Supply Voltage	VDDx	Supply voltage for core and analog	1.425	1.5	1.575	V	
Output Supply Voltage	VDDIO	Low voltage supply LP-HCSL outputs	0.95	1.05-1.5	1.575	V	
Ambient Operating Temperature	T_{AMB}	Commercial range	0	25	70	°C	1
		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	
Input Mid Voltage	V_{IM}	Single-ended tri-level inputs ('_tri' suffix)	0.4 V_{DD}		0.6 V_{DD}	V	
Input Low Voltage	V_{IL}	Single-ended inputs, except SMBus	-0.3		0.25 V_{DD}	V	
Input Current	I_{IN}	Single-ended inputs, V_{IN} = GND, V_{IN} = VDD	-5		5	µA	
	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	µA	
Input Frequency	F_{in}		1		167	MHz	2
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	1,5
	C_{OUT}	Output pin capacitance			6	pF	1
Clk Stabilization	T_{STAB}	From V_{DD} power-up and after input clock stabilization or de-assertion of PD# to 1st clock			1	ms	1,2
Input SS Modulation Frequency PCIe	$f_{MODINPCIe}$	Allowable Frequency for PCIe Applications (Triangular modulation)	30		33	kHz	
Input SS Modulation Frequency non-PCIe	f_{MODIN}	Allowable Frequency for non-PCIe Applications (Triangular Modulation)	0		66	kHz	
OE# Latency	$t_{LATOE\#}$	DIF start after OE# assertion DIF stop after OE# deassertion	1		3	clocks	1,3
Tdrive_PD#	t_{DRVPD}	DIF output enable after PD# de-assertion			300	µs	1,3
Tfall	t_F	Fall time of single-ended control inputs			5	ns	2
Trise	t_R	Rise time of single-ended control inputs			5	ns	2
SMBus Input Low Voltage	V_{ILSMB}				0.6	V	
SMBus Input High Voltage	V_{IHSMB}	V_{DDSMB} = 3.3V, see note 4 for V_{DDSMB} < 3.3V	2.1		3.3	V	4
SMBus Output Low Voltage	V_{OLSMB}	at I_{PULLUP}			0.4	V	
SMBus Sink Current	I_{PULLUP}	at V_{OL}	4			mA	
Nominal Bus Voltage	V_{DDSMB}	Bus Voltage	1.425		3.3	V	
SCLK/SDATA Rise Time	t_{RSMB}	(Max VIL - 0.15V) to (Min VIH + 0.15V)			1000	ns	1
SCLK/SDATA Fall Time	t_{FSMB}	(Min VIH + 0.15V) to (Max VIL - 0.15V)			300	ns	1
SMBus Operating Frequency	f_{MAXSMB}	Maximum SMBus operating frequency			400	kHz	6

[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] For V_{DDSMB} < 3.3V, V_{IHSMB} > = 0.8xV_{DDSMB}.

[5] DIF_IN input.

[6] The differential input clock must be running for the SMBus to be active.

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	dV/dt	Scope averaging on, fast setting	1	2.4	3.5	V/ns	1,2,3
	dV/dt	Scope averaging on, slow setting	0.7	1.7	2.5	V/ns	1,2,3
Slew Rate Matching	ΔdV/dt	Slew rate matching, scope averaging on		9	20	%	1,2,4
Voltage High	V_{HIGH}	Statistical measurement on single-ended signal using oscilloscope math function. (Scope averaging on)	630	750	850	mV	7
Voltage Low	V_{LOW}		-150	26	150		7
Max Voltage	Vmax	Measurement on single ended signal using absolute value. (Scope averaging off)		763	1150	mV	7
Min Voltage	Vmin		-300	22			7
Vswing	Vswing	Scope averaging off	300	1448		mV	1,2
Crossing Voltage (abs)	Vcross_abs	Scope averaging off	250	390	550	mV	1,5
Crossing Voltage (var)	Δ-Vcross	Scope averaging off		11	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.

[7] At default SMBus settings.

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_{DDA}	VDDO1.5+VDDR, at 100MHz		2.3	3	mA	
	I_{DDx}	VDDx, All outputs active at 100MHz		4.5	6	mA	
	I_{DDIO}	VDDIO, All outputs active at 100MHz		33	40	mA	
Powerdown Current	I_{DDAPD}	VDDO1.5+VDDR, CKPWRGD_PD# = 0		0.4	1	mA	2
	I_{DDxPD}	VDDx, CKPWRGD_PD# = 0		0.2	0.6	mA	2
	I_{DDIOPD}	VDDIO, CKPWRGD_PD# = 0		0.001	0.1	mA	2

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

[2] Input clock stopped.

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, at 100MHz	-1	-0.2	0.5	%	1,3
Skew, Input to Output	t_{pdBYP}	V_T = 50%	2400	2862	3700	ps	1
Skew, Output to Output	t_{sk3}	V_T = 50%		30	60	ps	1,4
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.

[4] All outputs at default slew rate.

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	$t_{jphPCIeG1}$	PCIe Gen 1		0.1	5	N/A	ps (p-p)	1,2,3,5
	$t_{jphPCIeG2}$	PCIe Gen 2 Lo Band 10kHz < f < 1.5MHz		0.1	0.4	N/A	ps (rms)	1,2,3,4, 5
		PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz)		0.1	0.7	N/A	ps (rms)	1,2,3,4
	$t_{jphPCIeG3}$	PCIe Gen 3 (2-4MHz or 2-5MHz, CDR = 10MHz)		0.1	0.3	N/A	ps (rms)	1,2,3,4
	$t_{jphSGMIIM0}$	125MHz, 1.5MHz to 10MHz, -20dB/decade rollover < 1.5MHz, -40db/decade rolloff > 10MHz		200	250	N/A	fs (rms)	1,6
	$t_{jphSGMIIM1}$	125MHz, 12kHz to 20MHz, -20dB/decade rollover < 1.5MHz, -40db/decade rolloff > 10MHz		313	350	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.

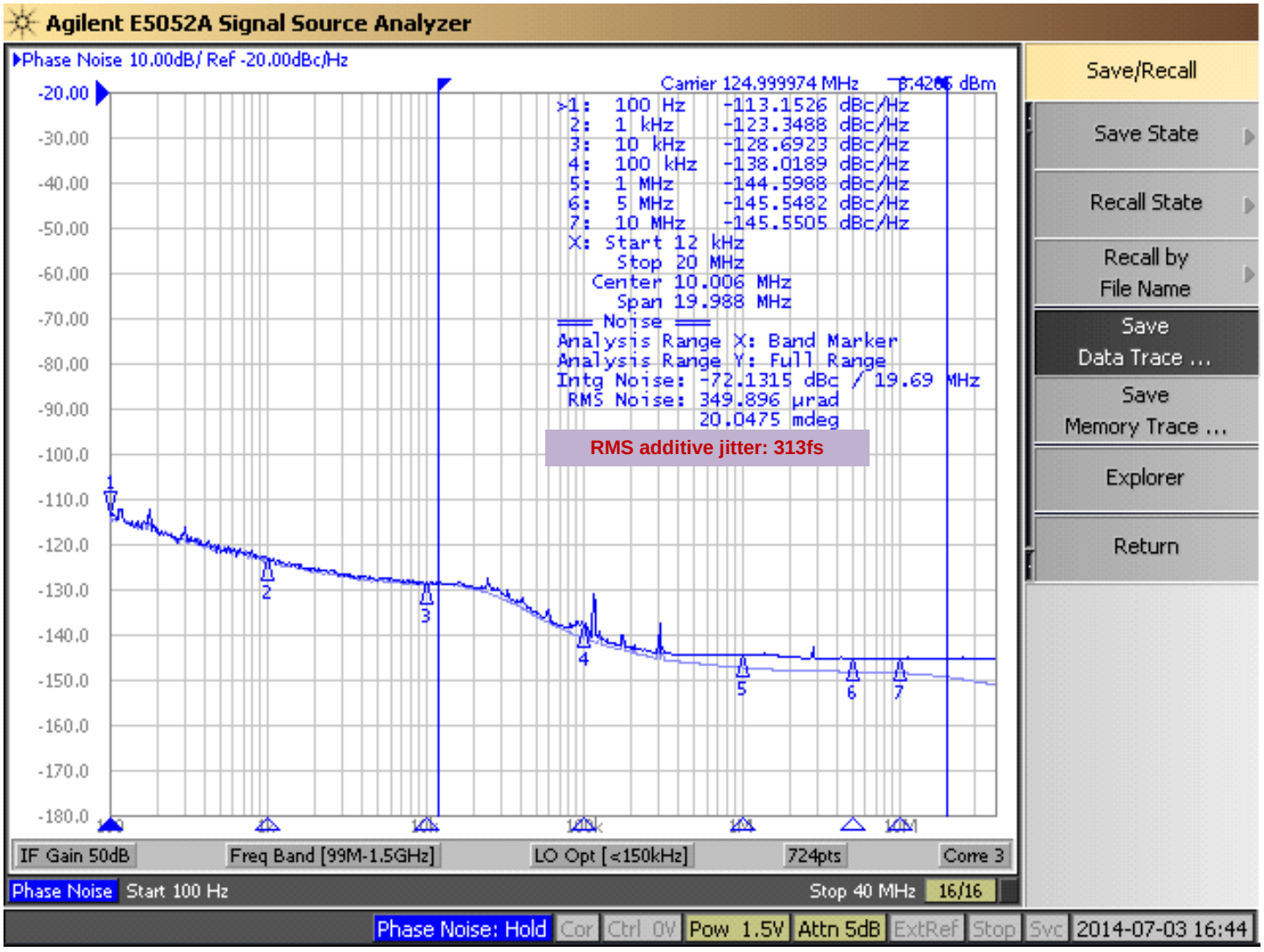
[3] Sample size of at least 100K cycles. This figure extrapolates to 108ps pk-pk @ 1M cycles for a BER of 1-12.

[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] Rohde & Schwarz SMA100.

Additive Phase Jitter Plot: 125M (12kHz to 20MHz)



General SMBus Serial Interface Information

How to Write

- Controller (host) sends a start bit
- Controller (host) sends the write address
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) sends the byte count = X
- IDT clock will **acknowledge**
- Controller (host) starts sending Byte **N through Byte N+X-1**
- IDT clock will **acknowledg**e each byte **one at a time**
- Controller (host) sends a stop bit

Index Block Write Operation			
Controller (Host)			**IDT (Slave/Receiver)**
T	starT bit		
Slave Address			
WR	WRite		
			ACK
Beginning Byte = N			
			ACK
Data Byte Count = X			
			ACK
Beginning Byte N		X Byte	
			ACK
O			
O			O
O			O
			O
Byte N + X - 1			
			ACK
P	stoP bit		

Note: SMBus Address is Latched on SADR pin.

How to Read

- Controller (host) will send a start bit
- Controller (host) sends the write address
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) will send a separate start bit
- Controller (host) sends the read address
- IDT clock will **acknowledge**
- IDT clock will send the data byte count = X
- IDT clock sends Byte **N+X-1**
- IDT clock sends **Byte 0 through Byte X (if $X_{(H)}$ was written to Byte 8)**
- Controller (host) will need to acknowledge each byte
- Controller (host) will send a not acknowledge bit
- Controller (host) will send a stop bit

Index Block Read Operation			
Controller (Host)			**IDT (Slave/Receiver)**
T	starT bit		
Slave Address			
WR	WRite		
			ACK
Beginning Byte = N			
			ACK
RT	Repeat starT		
Slave Address			
RD	ReaD		
			ACK
			Data Byte Count=X
ACK			
		X Byte	Beginning Byte N
ACK			
			O
O			O
O			O
O			
			Byte N + X - 1
N	Not acknowledge		
P	stoP bit		

SMBus Table: Output Enable Register [1]

Byte 0	Name	Control Function	Type	0	1	Default
Bit 7	DIF OE7	Output Enable	RW	Low/Low	Enabled	1
Bit 6	DIF OE6	Output Enable	RW	Low/Low	Enabled	1
Bit 5	DIF OE5	Output Enable	RW	Low/Low	Enabled	1
Bit 4	DIF OE4	Output Enable	RW	Low/Low	Enabled	1
Bit 3	DIF OE3	Output Enable	RW	Low/Low	Enabled	1
Bit 2	DIF OE2	Output Enable	RW	Low/Low	Enabled	1
Bit 1	DIF OE1	Output Enable	RW	Low/Low	Enabled	1
Bit 0	DIF OE0	Output Enable	RW	Low/Low	Enabled	1

1. A low on these bits will override the OE# pin and force the differential output Low/Low

SMBus Table: Output Enable and Output Amplitude Control Register

Byte 1	Name	Control Function	Type	0	1	Default
Bit 7	Reserved					0
Bit 6	Reserved					1
Bit 5	DIF OE8	Output Enable	RW	Low/Low	Enabled	1
Bit 4	Reserved					0
Bit 3	Reserved					1
Bit 2	Reserved					1
Bit 1	AMPLITUDE 1	Controls Output Amplitude	RW	00 = 0.55V	01= 0.65V	1
Bit 0	AMPLITUDE 0		RW	10 = 0.7V	11 = 0.8V	0

1. A low on the DIF OE bit will override the OE# pin and force the differential output Low/Low

SMBus Table: DIF Slew Rate Control Register

Byte 2	Name	Control Function	Type	0	1	Default
Bit 7	SLEWRATESEL DIF7	Adjust Slew Rate of DIF7	RW	Slow Setting	Fast Setting	1
Bit 6	SLEWRATESEL DIF6	Adjust Slew Rate of DIF6	RW	Slow Setting	Fast Setting	1
Bit 5	SLEWRATESEL DIF5	Adjust Slew Rate of DIF5	RW	Slow Setting	Fast Setting	1
Bit 4	SLEWRATESEL DIF4	Adjust Slew Rate of DIF4	RW	Slow Setting	Fast Setting	1
Bit 3	SLEWRATESEL DIF3	Adjust Slew Rate of DIF3	RW	Slow Setting	Fast Setting	1
Bit 2	SLEWRATESEL DIF2	Adjust Slew Rate of DIF2	RW	Slow Setting	Fast Setting	1
Bit 1	SLEWRATESEL DIF1	Adjust Slew Rate of DIF1	RW	Slow Setting	Fast Setting	1
Bit 0	SLEWRATESEL DIF0	Adjust Slew Rate of DIF0	RW	Slow Setting	Fast Setting	1

SMBus Table: DIF Slew Rate Control Register

Byte 3	Name	Control Function	Type	0	1	Default
Bit 7	Reserved					1
Bit 6	Reserved					1
Bit 5	Reserved					0
Bit 4	Reserved					0
Bit 3	Reserved					0
Bit 2	Reserved					1
Bit 1	Reserved					1
Bit 0	SLEWRATESEL DIF8	Adjust Slew Rate of DIF8	RW	Slow Setting	Fast Setting	1

Byte 4 is Reserved and reads back 'hFF

SMBus Table: Revision and Vendor ID Register

Byte 5	Name	Control Function	Type	0	1	Default
Bit 7	RID3	Revision ID	**R**	A rev = 0000		0
Bit 6	RID2		**R**			0
Bit 5	RID1		**R**			0
Bit 4	RID0		**R**			0
Bit 3	VID3	VENDOR ID	**R**	0001 = IDT		0
Bit 2	VID2		**R**			0
Bit 1	VID1		**R**			0
Bit 0	VID0		**R**			1

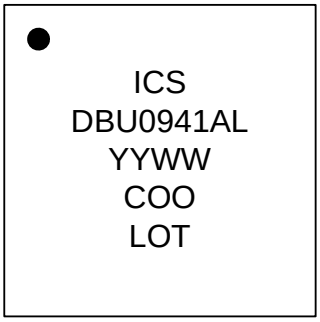
SMBus Table: Device Type/Device ID

Byte 6	Name	Control Function	Type	0	1	Default
Bit 7	Device Type1	Device Type	**R**	00 = FGx, 01 = DBx, 10 = DMx, 11= DBx w/oPLL		1
Bit 6	Device Type0		**R**			1
Bit 5	Device ID5	Device ID	**R**	001001binary or 09 hex		0
Bit 4	Device ID4		**R**			0
Bit 3	Device ID3		**R**			1
Bit 2	Device ID2		**R**			0
Bit 1	Device ID1		**R**			0
Bit 0	Device ID0		**R**			1

SMBus Table: Byte Count Register

Byte 7	Name	Control Function	Type	0	1	Default
Bit 7	Reserved					0
Bit 6	Reserved					0
Bit 5	Reserved					0
Bit 4	BC4	Byte Count Programming	RW	Writing to this register will configure how many bytes will be read back, default is = 8 bytes.		0
Bit 3	BC3		RW			1
Bit 2	BC2		RW			0
Bit 1	BC1		RW			0
Bit 0	BC0		RW			0

Marking Diagrams



Notes:

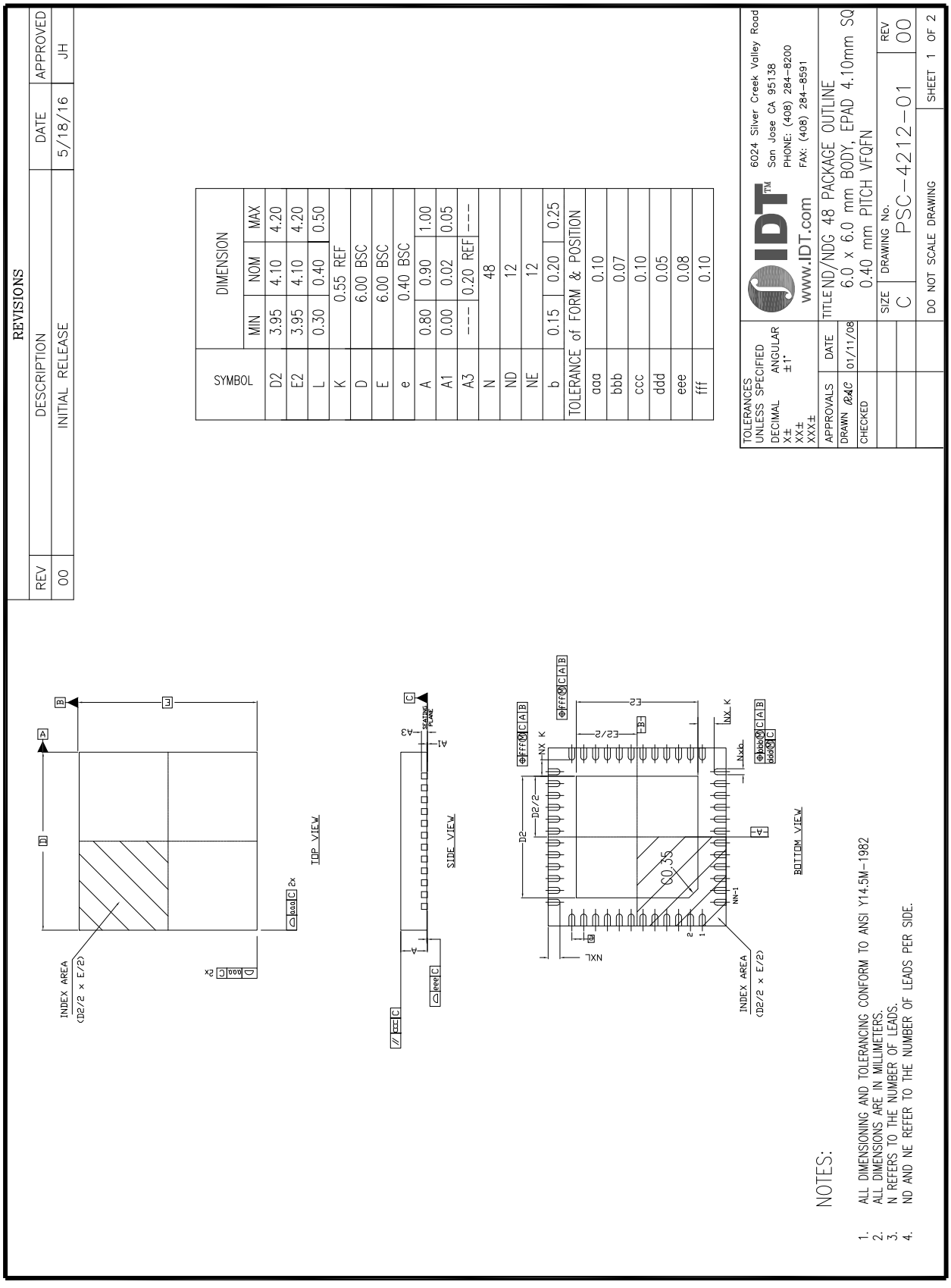
1. “LOT” is the lot sequence number.
2. “COO” denotes country of origin.
3. YYWW is the last two digits of the year and week that the part was assembled.
4. Line 2: truncated part number
5. “L” denotes RoHS compliant package.
6. “I” denotes industrial temperature range device.

Thermal Characteristics

PARAMETER	SYMBOL	CONDITIONS	PKG	TYP VALUE	UNITS	NOTES
Thermal Resistance	θ_{JC}	Junction to Case	NDG48	33	°C/W	1
	θ_{Jb}	Junction to Base		2.1	°C/W	1
	$\theta_{JA0\theta}$	Junction to Air, still air		37	°C/W	1
	θ_{JA1}	Junction to Air, 1 m/s air flow		30	°C/W	1
	θ_{JA3}	Junction to Air, 3 m/s air flow		27	°C/W	1
	θ_{JA5}	Junction to Air, 5 m/s air flow		26	°C/W	1

[1]ePad soldered to board

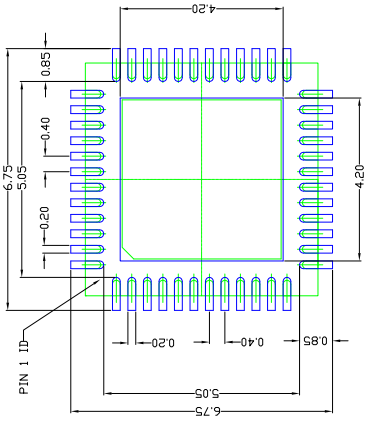
Package Outline and Dimensions (NDG48)



Package Outline and Dimensions (NDG48), cont.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
00	INITIAL RELEASE	5/18/16	JH



RECOMMENDED LAND PATTERN DIMENSION

NOTES:
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. TOP DOWN VIEW. AS VIEWED ON PCB.
3. COMPONENT OUTLINE SHOWS FOR REFERENCE IN GREEN.
4. LAND PATTERN IN BLUE. NSMD PATTERN ASSUMED.
5. LAND PATTERN RECOMMENDATION PER IPC-7351B GENERIC REQUIREMENT FOR SURFACE MOUNT DESIGN AND LAND PATTERN.

TOLERANCES
UNLESS SPECIFIED
DECIMAL ANGULAR
X± ±1°
XX±
XXX±

APPROVALS DATE
DRAWN BAC 01/11/08
CHECKED

IDT™ 6024 Silver Creek Valley Road
San Jose CA 95138
PHONE: (408) 284-8200
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TITLE NDG 48 PACKAGE OUTLINE
6.0 x 6.0 mm BODY, EPAD 4.10mm SQ
0.40 mm PITCH VFQFN

SIZE C | DRAWING No. PSC-4212-01 | REV 00

DO NOT SCALE DRAWING | SHEET 2 OF 2

Ordering Information

Part / Order Number	Shipping Packaging	Package	Temperature
9DBU0941AKLF	Trays	48-pin VFQFPN	0 to +70° C
9DBU0941AKLFT	Tape and Reel	48-pin VFQFPN	0 to +70° C
9DBU0941AKILF	Trays	48-pin VFQFPN	-40 to +85° C
9DBU0941AKILFT	Tape and Reel	48-pin VFQFPN	-40 to +85° C

"LF" suffix to the part number are the Pb-Free configuration and are 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	7/15/2014	Final update and release - front page and electrical tables.	Various
B	RDW	9/19/2014	Updated SMBus Input High/Low parameters conditions, MAX values, and footnotes.	6
C	RDW	4/17/2015	1. Minor updates to front page text for family consistency. 2. Updated Clock Input Parameters table to be consistent with PCIe Vswing parameter.	1,5
D	RDW	2/16/2017	1. Updated pins 30 and 29 from VDDA1.5 and GNDA to VDDO1.5 and GND to clearly indicate that this part has no PLL.	2, 3
E	RDW	3/9/2017	1. Removed "Bypass Mode" reference in "Output Duty Cycle..." and "Phase Jitter Parameters" tables; update note 3 under Output Duty Cycle table. 2. Corrected spelling errors/typos. 3. Change VDDA to VDDO1.5 in Current Consumption table. 4. Update Additive Phase Jitter conditions for PCIe Gen3.	7,8

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