

# 1.8V, 11 Output Clock Multiplier, Distributor, Jitter Cleaner, and Buffer

Check for Samples: [CDCL6010](#)

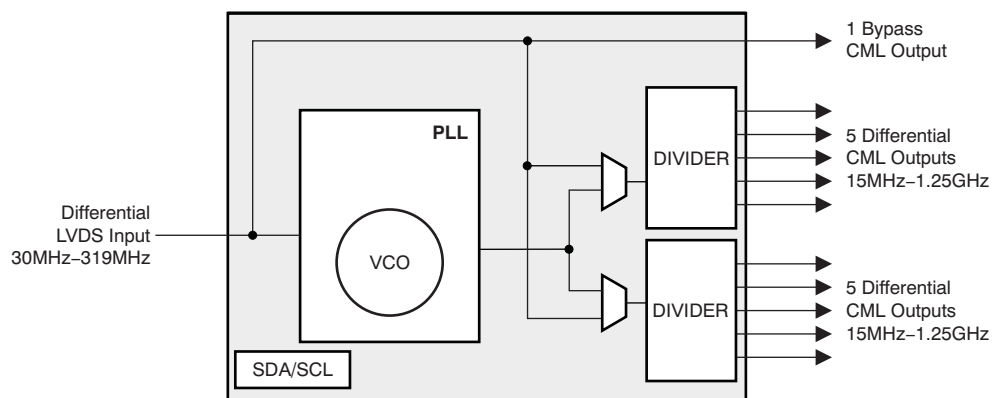
## FEATURES

- Single 1.8V Supply
- High-Performance Clock Multiplier, Distributor, Jitter Cleaner, and Buffer With 11 Outputs
- Low Output Jitter: 400fs RMS
- Output Group Phase Adjustment
- Low-Voltage Differential Signaling (LVDS) Input, 100Ω Differential On-Chip Termination, 30MHz to 319MHz Frequency Range
- Differential Current Mode Logic (CML) Outputs, 50Ω Single-Ended On-Chip Termination, 15MHz to 1.25GHz Frequency Range
- One Dedicated Differential CML Output, Straight PLL and Frequency Divider Bypass
- Two Groups of Five Outputs Each with Independent Frequency Division Ratios; Optional PLL Bypass
- Fully Integrated Voltage Controlled Oscillator (VCO); Supports Wide Output Frequency Range
- Output Frequency Derived From VCO Frequency with Divide Ratios of 1, 2, 4, 5, 8, 10, 16, 20, 32, 40, and 80
- Meets OBSAI RP1 v1.0 Standard and CPRI v2.0 Requirements
- Meets ANSI TIA/EIA-644-A-2001 LVDS Standard Requirements

- Integrated LC Oscillator Allows External Bandwidth Adjustment
- PLL Lock Indication
- Power Consumption: 640mW Typical
- Output Enable Control for Each Output
- SDA/SCL Device Management Interface
- 48-pin QFN (RGZ) Package
- Industrial Temperature Range: –40°C to +85°C

## APPLICATIONS

- Low Jitter Clocking for High-Speed SERDES
- Jitter Cleaning of SERDES Reference Clocks for 1G/10G Ethernet, 1X/2X/4X/10X Fibre Channel, PCI Express, Serial ATA, SONET, CPRI, OBSAI, etc.
- Up to 1-to-11 Clock Buffering and Fan-out



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This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## DESCRIPTION

The CDCL6010 is a high-performance, low phase noise clock multiplier, distributor, jitter cleaner, and low skew buffer. It effectively cleans a noisy system clock with a fully-integrated low noise Voltage Controlled Oscillator (VCO) that operates in the 1.2GHz–1.275GHz range. (Note that the LC oscillator oscillates in the 2.4GHz–2.55GHz range. The frequency is predivided by 2 before the post-dividers P0 and P1.)

The output frequency ( $F_{OUT}$ ) is synchronized to the frequency of the input clock ( $F_{IN}$ ). The programmable pre-dividers, M and N, and the post-dividers, P0 and P1, give a high flexibility to the ratio of the output frequency to the input frequency:

$$F_{OUT} = F_{IN} \times N / (M \times P)$$

Where:

$$P (P0, P1) = 1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 80$$

$$M = 1, 2, 4, 8$$

$$N = 32, 40$$

provided that:

$$30\text{MHz} < (F_{IN} / M) < 40\text{MHz}$$

$$1200\text{MHz} < (F_{OUT} \times P) < 1275\text{MHz}$$

The PLL loop bandwidth is user-selectable by external filter components or by using the internal loop filter. The PLL loop bandwidth and damping factor can be adjusted to meet different system requirements.

The CDCL6010 supports one differential LVDS clock input and a total of 11 differential CML outputs. One output is a straight bypass with no support for jitter cleaning or clock multiplication. The remaining 10 outputs are available in two groups of five outputs each with independent frequency division ratios. Those 10 outputs can be optionally setup to bypass the PLL when no jitter cleaning is needed. The CML outputs are compatible with LVDS receivers if ac-coupled.

With careful observation of the input voltage swing and common-mode voltage limits, the CDCL6010 can support a single-ended clock input as outlined in the Pin Description Table

The CDCL6010 can operate as a multi-output clock buffer in a PLL bypass mode.

All device settings are programmable through the SDA/SCL, serial two-wire interface.

The serial interface is 1.8V tolerant only.

The phase of one output group relative to the other can be adjusted through the SDA/SCL interface. For post-divide ratios (P0, P1) that are multiples of 5, the total number of phase adjustment steps ( $n$ ) equals the divide-ratio divided by 5. For post-divide ratios (P0, P1) that are not multiples of 5, the total number of steps ( $n$ ) is the same as the post-divide ratio. The phase adjustment step ( $\Delta\Phi$ ) in time units is given as:

$$\Delta\Phi = 1 / (n \times F_{OUT})$$

where  $F_{OUT}$  is the respective output frequency.

The device operates in a 1.8V supply environment and is characterized for operation from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

The CDCL6010 is available in a 48-pin QFN (RGZ) package.

**Table 1. AVAILABLE OPTIONS<sup>(1)</sup>**

$T_A$	PACKAGED DEVICES	FEATURES
$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$	CDCL6010RGZT	48-pin QFN (RGZ) Package, small tape and reel
$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$	CDCL6010RGZR	48-pin QFN (RGZ) Package, tape and reel

(1) For the most current specifications and package information, see the Package Option Addendum located at the end of this data sheet or refer to our web site at [www.ti.com](http://www.ti.com).

## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted).<sup>(1)</sup>

		VALUE	UNIT
V <sub>DD</sub> , AV <sub>DD</sub>	Supply voltage <sup>(2)</sup>	–0.3 to 2.5	V
V <sub>LVDS</sub>	Voltage range at LVDS input pins <sup>(2)</sup>	–0.3 to V <sub>DD</sub> + 0.6	V
V <sub>I</sub>	Voltage range at all non-LVDS input pins <sup>(2)</sup>	–0.3 to V <sub>DD</sub> + 0.6	V
ESD	Electrostatic discharge (HBM)	2	kV
T <sub>J</sub>	Junction temperature	+125	°C
T <sub>STG</sub>	Storage temperature range	–65 to +150	°C

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating condition* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltage values are with respect to network ground terminal.

## RECOMMENDED OPERATING CONDITIONS

Over operating free-air temperature range (unless otherwise noted).

		MIN	NOM	MAX	UNIT
V <sub>DD</sub>	Digital supply voltage	1.7	1.8	1.9	V
AV <sub>DD</sub>	Analog supply voltage	1.7	1.8	1.9	V
T <sub>A</sub>	Ambient temperature (no airflow, no heatsink)	–40		+85	°C
T <sub>J</sub>	Junction temperature			+105	°C

## THERMAL INFORMATION

THERMAL METRIC <sup>(1)</sup>			RGZ (48 Pins)	UNITS
θ <sub>JA</sub>	Junction-to-ambient thermal resistance <sup>(2)</sup> :	airflow = 0 lfm	28.3	°C/W
		airflow = 50 lfm	22.4	°C/W
θ <sub>JC(TOP)</sub>	Junction-to-case (top) thermal resistance		20.5	°C/W
θ <sub>JC(BOTTOM)</sub>	Junction-to-case (Bottom) thermal resistance		5.3	°C/W

(1) For more information about traditional and new thermal metrics, see the IC Package Thermal Metrics application report, [SPRA953](#).

(2) No heatsink; power uniformly distributed; 36 ground vias (6 x 6 array) tied to the thermal exposed pad; 4-layer high-K board.

## DC ELECTRICAL CHARACTERISTICS

Over recommended operating conditions (unless otherwise noted).

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I <sub>VDD</sub>	Total current from digital 1.8V supply	All outputs enabled; V <sub>DD</sub> = V <sub>DD,typ</sub> 30.72MHz input; 61.44MHz output		270		mA
I <sub>AVDD</sub>	Total current from analog 1.8V supply	All outputs enabled; AV <sub>DD</sub> = V <sub>DD,typ</sub> 30.72MHz input; 61.44MHz output		85		mA
V <sub>IL,CMOS</sub>	Low level CMOS input voltage	V <sub>DD</sub> = 1.8V	–0.2		0.6	V
V <sub>IH,CMOS</sub>	High level CMOS input voltage	V <sub>DD</sub> = 1.8V	V <sub>DD</sub> – 0.6		V <sub>DD</sub>	V
I <sub>IL,CMOS</sub>	Low level CMOS input current	V <sub>DD</sub> = V <sub>DD,max</sub> , V <sub>IL</sub> = 0.0V			–120	μA
I <sub>IH,CMOS</sub>	High level CMOS input current	V <sub>DD</sub> = V <sub>DD,max</sub> , V <sub>IH</sub> = 1.9V			65	μA
V <sub>OL,SDA</sub>	Low level CMOS output voltage for the SDA pin	Sink current = 3mA	0		0.2V <sub>DD</sub>	V
I <sub>OL,CMOS</sub>	Low level CMOS output current				8	mA

## AC ELECTRICAL CHARACTERISTICS

Over recommended operating conditions (unless otherwise noted).

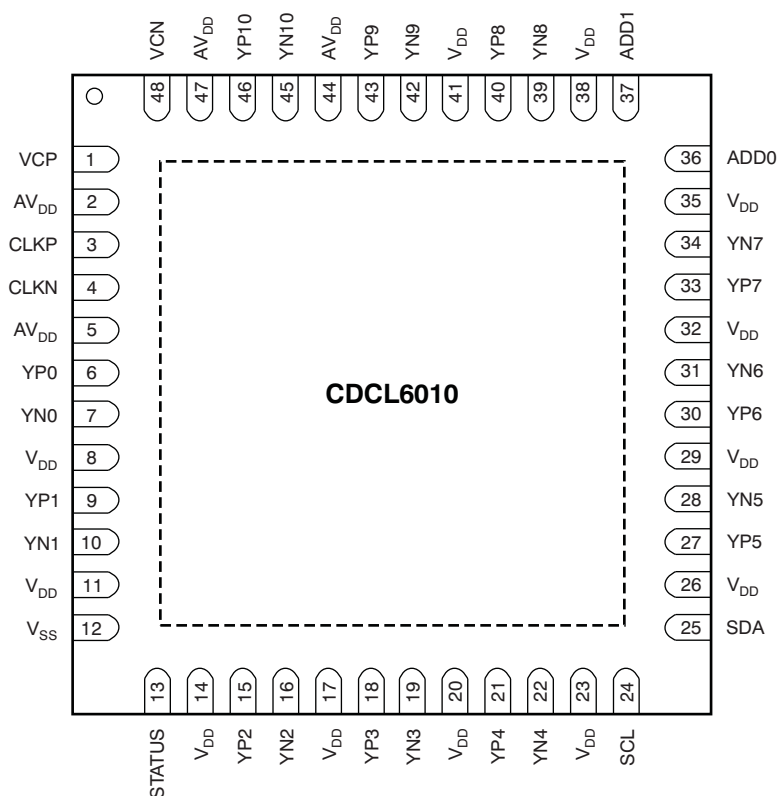
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$Z_{D,IN}$	Differential input impedance for the LVDS input terminals		90		132	$\Omega$
$V_{CM,IN}$	Common-mode voltage, LVDS input		1125	1200	1375	mV
$V_{S,IN}$	Single-ended LVDS input voltage swing		100		600	mV <sub>PP</sub>
$V_{D,IN}$	Differential LVDS input voltage swing		200		1200	mV <sub>PP</sub>
$t_{R,OUT}$ , $t_{F,OUT}$	Output signal rise/fall time	20%–80%		100		ps
$V_{CM,OUT}$	Common-mode voltage, CML outputs		$V_{DD} - 0.31$	$V_{DD} - 0.23$	$V_{DD} - 0.19$	V
$V_{S,OUT}$	Single-ended CML output voltage swing	ac-coupled	180	230	280	mV <sub>PP</sub>
$V_{D,OUT}$	Differential CML output voltage swing	Measured in a 50 $\Omega$ scope; The CML output incorporates 50 $\Omega$ resistors to $V_{DD}$	360	460	560	mV <sub>PP</sub>
$F_{IN}$	Clock input frequency		30		319	MHz
$F_{OUT}$	Clock output frequency		15		1250	MHz
$L_{OUT}$	Residual clock output phase noise	$F_{IN} = 30.72\text{MHz}$ , $F_{OUT} = 61.44\text{MHz}$ 400kHz PLL bandwidth  at 10Hz offset at 100Hz offset at 1kHz offset at 10kHz offset at 100kHz offset at 1MHz offset at 10MHz offset at 20MHz offset		–103 –114 –123 –121 –119 –138 –152 –152		 dBc/Hz dBc/Hz dBc/Hz dBc/Hz dBc/Hz dBc/Hz dBc/Hz dBc/Hz
$J_{OUT}$	Residual clock output jitter	$F_{IN} = 30.72\text{MHz}$ , $F_{OUT} = 61.44\text{MHz}$ 400kHz PLL bandwidth  10Hz–1MHz offset 1MHz–20MHz offset 12kHz–20MHz offset		2.01 0.45 2.11		 ps RMS ps RMS ps RMS
$T_P$	Input-to-output delay	$F_{IN} = 30.72\text{MHz}$ , $F_{OUT} = 30.72\text{MHz}$ YP[9:0] outputs, PLL bypass mode		3		ns
		$F_{IN} = 30.72\text{MHz}$ , $F_{OUT} = 61.44\text{MHz}$ YP[9:0] outputs, PLL mode		150		ps
$TS_{OUT}$	Clock output skew	$F_{IN} = 30.72\text{MHz}$ , $F_{OUT} = 61.44\text{MHz}$ YP[9:0] outputs relative to YP[0]	–64		64	ps
		$F_{IN} = 122.88\text{MHz}$ , $F_{OUT}$ (Y0 to Y4) = 61.44MHz, $F_{OUT}$ (Y5 to Y9) = 122.88MHz (Y0 to Y4) lag (Y5 to Y9)	1.46		2.52	ns
$DCycle_{OUT}$	Clock output duty cycle <sup>(1)</sup>		45%		55%	

(1) Output duty cycle of the bypass output and for post-divide ratio = 1 is just as good as the input duty cycle.

**AC ELECTRICAL CHARACTERISTICS FOR THE SDA/SCL INTERFACE<sup>(1)</sup>**

PARAMETER		MIN	TYP	MAX	UNIT
$f_{SCL}$	SCL frequency			400	kHz
$t_{h(START)}$	START hold time	0.6			$\mu s$
$t_{w(SCLL)}$	SCL low-pulse duration	1.3			$\mu s$
$t_{w(SCLH)}$	SCL high-pulse duration	0.6			$\mu s$
$t_{su(START)}$	START setup time	0.6			$\mu s$
$t_{h(SDATA)}$	SDA hold time	0			$\mu s$
$t_{su(DATA)}$	SDA setup time	0.6			$\mu s$
$t_{r(SDATA)}$	SCL / SDA input rise time			0.3	$\mu s$
$t_{f(SDATA)}$	SCL / SDA input fall time			0.3	$\mu s$
$t_{su(STOP)}$	STOP setup time	0.6			$\mu s$
$t_{BUS}$	Bus free time	1.3			$\mu s$

(1) See [Figure 4](#) for the timing behavior.

**DEVICE INFORMATION****48-PIN QFN (RGZ)  
(TOP VIEW)**

NOTE: Exposed thermal pad must be soldered to  $V_{SS}$ .

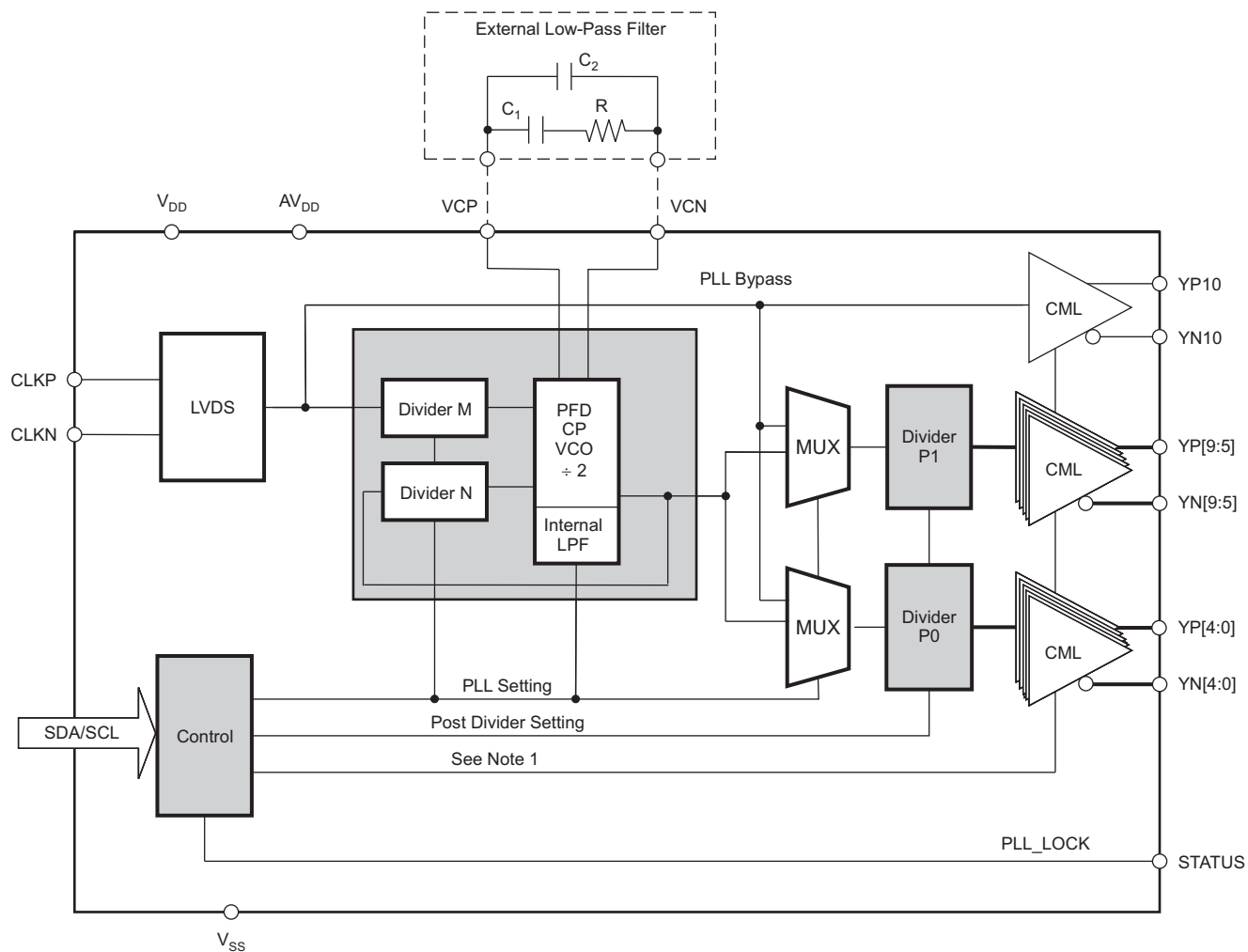
The CDCL6010 is available in a 48-pin QFN (RGZ) package with a pin pitch of 0,5mm. The exposed thermal pad serves both thermal and electrical grounding purposes.

**NOTE**

The device must be soldered to ground ( $V_{SS}$ ) using as many ground vias as possible. The device performance will be severely impacted if the exposed thermal pad is not grounded appropriately.

## PIN FUNCTIONS

PIN		TYPE	DESCRIPTION
NAME	PIN NO.		
V <sub>DD</sub>	8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41	Power	1.8V digital power supply.
AV <sub>DD</sub>	2, 5, 44, 47	Power	1.8V analog power supply.
V <sub>SS</sub>	Exposed thermal pad and pin 12	Power	Ground reference.
VCP, VCN	1, 48	I	External loop filter terminals.
CLKP, CLKN	3, 4	I	Differential LVDS input. Single-ended 1.8V input can be dc-coupled to pin 3 with pin 4 either tied to pin 3 (recommended) or left open.
YP0, YN0 YP1, YN1 YP2, YN2 YP3, YN3 YP4, YN4 YP5, YN5 YP6, YN6 YP7, YN7 YP8, YN8 YP9, YN9	6, 7 9, 10 15, 16 18, 19 21, 22 27, 28 30, 31 33, 34 40, 39 43, 42	O	10 differential CML outputs with support for jitter cleaning and clock multiplication. Support optional PLL bypass mode when jitter cleaning is not needed.
YP10, YN10	46, 45	O	Differential CML output. Straight bypass with no jitter cleaning and no clock multiplication.
SCL	24	I	SCL serial clock pin. Open drain. Always connect to a pull-up resistor. SCL tolerated 1.8V on the input only.
SDA	25	I/O	SDA bidirectional serial data pin. Open drain. Always connect to a pull-up resistor. SDA tolerates 1.8V on the input only.
STATUS	13	O	LVC MOS status signaling. High status indicates PLL lock.
ADD1, ADD0	37, 36	I	Configurable least significant bits (ADD[1:0]) of the SDA/SCL device address. The fixed most significant bits (ADD[6:2]) of the 7-bit device address are 11010.

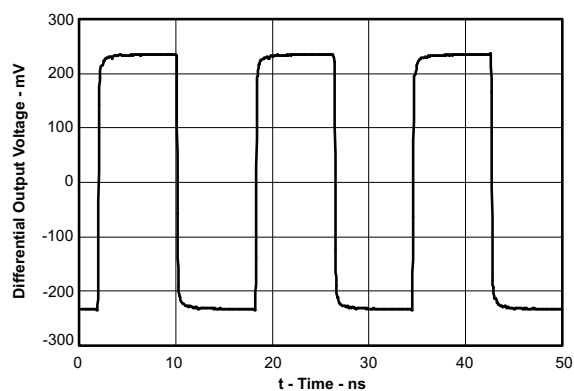
**FUNCTIONAL BLOCK DIAGRAM**

- (1) Outputs can be disabled to floating. When outputs are left floating, internal 50 $\Omega$  termination to  $V_{DD}$  pulls both YN and YP to  $V_{DD}$ .

## TYPICAL CHARACTERISTICS

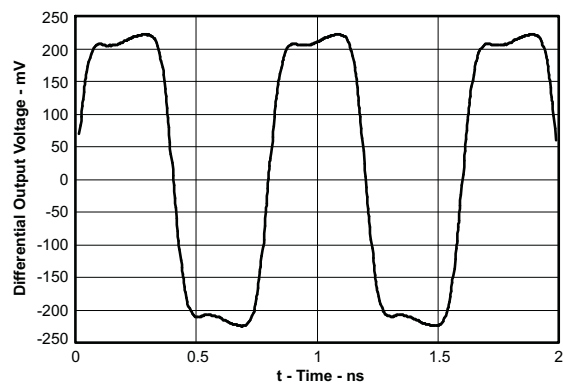
Typical operating conditions are at  $V_{DD} = 1.8V$  and  $T_A = +25^\circ C$ ,  $V_{D,IN} = 200mV_{PP}$  (unless otherwise noted).

**TRANSIENT PERFORMANCE:**  
 $F_{IN} = 30.72MHz$ ,  $F_{OUT} = 61.44MHz$



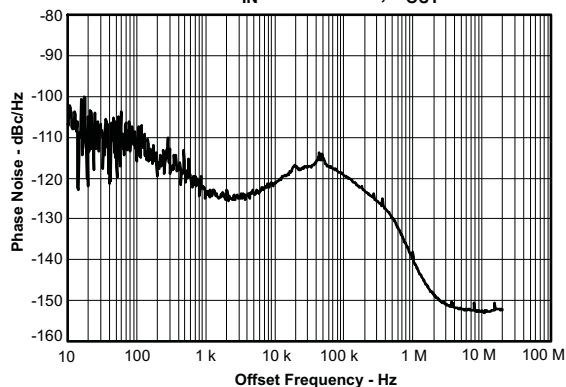
**Figure 1.**

**TRANSIENT PERFORMANCE:**  
 $F_{IN} = 250MHz$ ,  $F_{OUT} = 1.25GHz$



**Figure 2.**

**PHASE NOISE:  $F_{IN} = 30.72MHz$ ,  $F_{OUT} = 61.44MHz$**



**Figure 3.**

## SDA/SCL INTERFACE

This section describes the SDA/SCL interface of the CDCL6010 device. The CDCL6010 operates as a slave device of the industry standard 2-pin SDA/SCL bus. It operates in the fast-mode at a bit-rate of up to 400kbit/s and supports 7-bit addressing compatible with the popular two-pin serial interface standard.

### SDA/SCL Bus Slave Device Address

A6	A5	A4	A3	A2	A1	A0	R/W
1	1	0	1	0	ADD1	ADD0	0/1

The device address is made up of the fixed internal address, 11010 (A6:A2), and configurable external pins ADD1 (A1) and ADD0 (A0). Four different devices with addresses 1101000, 1101001, 1101010 and 1101011, can be addressed via the same SDA/SCL bus interface. The least significant bit of the address byte designates a write or read operation.

R/W Bit:

0 = Write to CDCL6010 device

1 = Read from CDCL6010 device

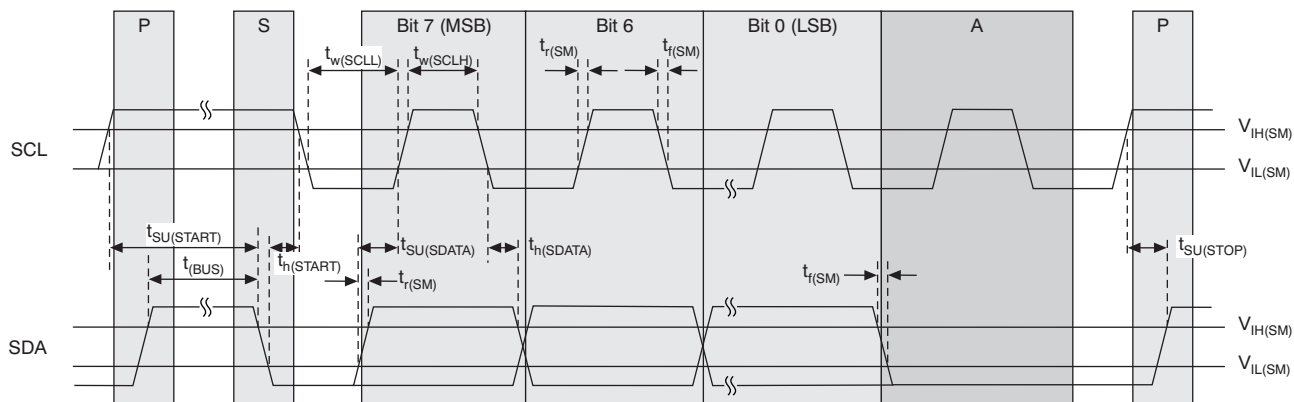
### Command Code Definition

BIT	DESCRIPTION
C7	1 = <i>Byte Write / Read</i> or <i>Word Write / Read</i> operation
(C6:C0)	Byte Offset for <i>Byte Write / Read</i> and <i>Word Write / Read</i> operation.

Command Code for <i>Byte Write / Read</i> Operation	Hex Code	C7	C6	C5	C4	C3	C2	C1	C0
Byte 0	80h	1	0	0	0	0	0	0	0
Byte 1	81h	1	0	0	0	0	0	0	1
Byte 2	82h	1	0	0	0	0	0	1	0
Byte 3	83h	1	0	0	0	0	0	1	1
Byte 4	84h	1	0	0	0	0	1	0	0
Byte 5	85h	1	0	0	0	0	1	0	1
Byte 6	86h	1	0	0	0	0	1	1	0
Byte 7	87h	1	0	0	0	0	1	1	1

Command Code for <i>Word Write / Read</i> Operation	Hex Code	C7	C6	C5	C4	C3	C2	C1	C0
Word 0: Byte 0 and byte 1	80h	1	0	0	0	0	0	0	0
Word 1: Byte 1 and byte 2	81h	1	0	0	0	0	0	0	1
Word 2: Byte 2 and byte 3	82h	1	0	0	0	0	0	1	0
Word 3: Byte 3 and byte 4	83h	1	0	0	0	0	0	1	1
Word 4: Byte 4 and byte 5	84h	1	0	0	0	0	1	0	0
Word 5: Byte 5 and byte 6	85h	1	0	0	0	0	1	0	1
Word 6: Byte 6 and byte 7	86h	1	0	0	0	0	1	1	0
Word 7: Byte 7	87h	1	0	0	0	0	1	1	1

## SDA/SCL Timing Characteristics



**Figure 4. Timing Diagram for the SDA/SCL Serial Control Interface**

## SDA/SCL Programming Sequence

### LEGEND FOR PROGRAMMING SEQUENCE

1	7	1	1	8	1	1
S	Slave Address	Wr	A	Data Byte	A	P

- S Start condition
- Sr Repeated start condition
- Rd Read (bit value = 1)
- Wr Write (bit value = 0)
- A Acknowledge (bit value = 0)
- N Not acknowledge (bit value = 1)
- P Stop condition
- Master to Slave transmission
- Slave to Master transmission

### Byte Write Programming Sequence:

1	7	1	1	8	1	8	1	1
S	Slave Address	Wr	A	Command Code	A	Data Byte	A	P

### Byte Read Programming Sequence:

1	7	1	1	8	1	1	7	1	1	8	1	1
S	Slave Address	Wr	A	Command Code	A	S	Slave Address	Rd	A	Data Byte	N	P

**Word Write Programming Sequence:**

1	7	1	1	8	1	8	1	8	1	1
S	Slave Address	Wr	A	Command Code	A	Data Byte Low	A	Data Byte High	A	P

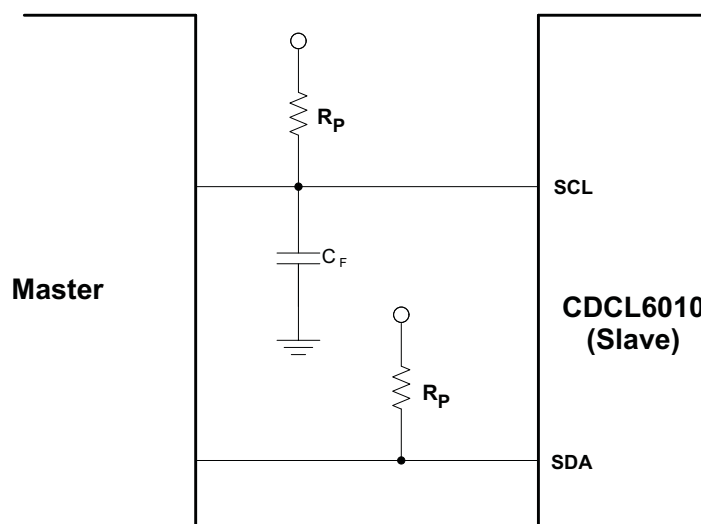
**Word Read Programming Sequence:**

1	7	1	1	8	1	1	7	1	1	8	1	8	1	1
S	Slave Address	Wr	A	Command Code	A	S	Slave Address	Rd	A	Data Byte	A	Data Byte	N	P

**SDA/SCL Connections Recommendations**

The serial interface inputs don't have glitch suppression circuit. So, any noises or glitches at serial input lines may cause programming error. The serial interface lines should be routed in such a way that the lines would have minimum noise impact from the surroundings.

Figure 5 is recommended to improve the interconnections.



**Figure 5. Serial Interface Connections**

Lower  $R_P$  resistor value (around 1 k $\Omega$ ) should be chosen so that signals will have faster rise time. A capacitor can be connected to SCL line to ground which will act as a filter.

An I<sup>2</sup>C level translator will help to overcome the noises issue.

## SDA/SCL Bus Configuration Command Bitmap

### Byte 0:

Bit	Bit Name	Description/Function	Type	Power Up Condition	Reference To
7	PLL-LOCK	1 if PLL has achieved lock, otherwise 0	R	0	
6	MANF[6]	Manufacturer reserved	R		
5	MANF[5]	Manufacturer reserved	R		
4	MANF[4]	Manufacturer reserved	R		
3	MANF[3]	Manufacturer reserved	R		
2	MANF[2]	Manufacturer reserved	R		
1	MANF[1]	Manufacturer reserved	R		
0	MANF[0]	Manufacturer reserved	R		

### Byte 1:

Bit	Bit Name	Description/Function	Type	Power Up Condition	Reference To
7	RES	Reserved	R/W	0	
6	RES	Reserved	R/W	0	
5	ENPH	Phase select enable	R/W	1	
4	PH1[4]	Phase select for YP[9:5] and YN[9:5]	R/W	0	<a href="#">Table 5, Table 6</a>
3	PH1[3]	Phase select for YP[9:5] and YN[9:5]	R/W	0	<a href="#">Table 5, Table 6</a>
2	PH1[2]	Phase select for YP[9:5] and YN[9:5]	R/W	0	<a href="#">Table 5, Table 6</a>
1	PH1[1]	Phase select for YP[9:5] and YN[9:5]	R/W	0	<a href="#">Table 5, Table 6</a>
0	PH1[0]	Phase select for YP[9:5] and YN[9:5]	R/W	0	<a href="#">Table 5, Table 6</a>

### Byte 2:

Bit	Bit Name	Description/Function	Type	Power Up Condition	Reference To
7	RES	Reserved	R/W	0	
6	RES	Reserved	R/W	0	
5	ENP1	Post-divider P1 enable; if 0 output YP[9:5] and YN[9:5] are disabled	R/W	1	
4	ENBP1	Bypass PLL for post-divider P1: If 1 input is CLKP/CLKN, if 0 input is PLL clock	R/W	0	
3	SELP1[3]	Divide ratio select for post-divider P1	R/W	0	<a href="#">Table 2</a>
2	SELP1[2]	Divide ratio select for post-divider P1	R/W	1	<a href="#">Table 2</a>
1	SELP1[1]	Divide ratio select for post-divider P1	R/W	1	<a href="#">Table 2</a>
0	SELP1[0]	Divide ratio select for post-divider P1	R/W	1	<a href="#">Table 2</a>

**Byte 3:**

Bit	Bit Name	Description/Function	Type	Power Up Condition	Reference To
7	RES	Reserved	R/W	0	
6	RES	Reserved	R/W	0	
5	PLLLOCKOW	PLL Lock Overwrite: If 1 output not gated by PLL Lock status.	R/W	0	
4	PH0[4]	Phase select for YP[4:0] and YN[4:0]	R/W	0	<a href="#">Table 5, Table 6</a>
3	PH0[3]	Phase select for YP[4:0] and YN[4:0]	R/W	0	<a href="#">Table 5, Table 6</a>
2	PH0[2]	Phase select for YP[4:0] and YN[4:0]	R/W	0	<a href="#">Table 5, Table 6</a>
1	PH0[1]	Phase select for YP[4:0] and YN[4:0]	R/W	0	<a href="#">Table 5, Table 6</a>
0	PH0[0]	Phase select for YP[4:0] and YN[4:0]	R/W	0	<a href="#">Table 5, Table 6</a>

**Byte 4:**

Bit	Bit Name	Description/Function	Type	Power Up Condition	Reference To
7	RES	Reserved	R/W	0	
6	RES	Reserved	R/W	0	
5	ENP0	Post-divider P0 enable. If 0, output YP[4:0] and YN[4:0] are disabled	R/W	1	
4	ENBP0	Bypass PLL for post-divider P0. If 1, input is CLKP/CLKN; if 0 input is PLL clock	R/W	0	
3	SELP0[3]	Divide ratio select for post-divider P0	R/W	0	<a href="#">Table 2</a>
2	SELP0[2]	Divide ratio select for post-divider P0	R/W	1	<a href="#">Table 2</a>
1	SELP0[1]	Divide ratio select for post-divider P0	R/W	1	<a href="#">Table 2</a>
0	SELP0[0]	Divide ratio select for post-divider P0	R/W	1	<a href="#">Table 2</a>

**Byte 5:**

Bit	Bit Name	Description/Function	Type	Power Up Condition	Reference To
7	EN	Chip enable; if 0 chip is in Iddq mode	R/W	1	
6	ENDRV10	YP10, YN10 enable; if 0 output is disabled	R/W	1	
5	ENDRV9	YP[9], YN[9] enable; if 0 output is disabled	R/W	1	
4	ENDRV8	YP[8], YN[8] enable; if 0 output is disabled	R/W	1	
3	ENDRV7	YP[7], YN[7] enable; if 0 output is disabled	R/W	1	
2	ENDRV6	YP[6], YN[6] enable; if 0 output is disabled	R/W	1	
1	ENDRV5	YP[5], YN[5] enable; if 0 output is disabled	R/W	1	
0	ENDRV4	YP[4], YN[4] enable; if 0 output is disabled	R/W	1	

**Byte 6:**

Bit	Bit Name	Description/Function	Type	Power Up Condition	Reference To
7	ENDRV3	YP[3], YN[3] enable; if 0 output is disabled	R/W	1	
6	ENDRV2	YP[2], YN[2] enable; if 0 output is disabled	R/W	1	
5	ENDRV1	YP[1], YN[1] enable; if 0 output is disabled	R/W	1	
4	ENDRV0	YP[0], YN[0] enable; if 0 output is disabled	R/W	1	
3	SELBW[3]	PLL BW select; if 1 external loop filter is expected	R/W	0	<a href="#">Table 7</a>
2	SELBW[2]	PLL BW select; if 1 external loop filter is expected	R/W	0	<a href="#">Table 7</a>
1	SELBW[1]	PLL BW select; if 1 external loop filter is expected	R/W	0	<a href="#">Table 7</a>
0	SELBW[0]	PLL BW select; if 1 external loop filter is expected	R/W	0	<a href="#">Table 7</a>

**Byte 7:**

Bit	Bit Name	Description/Function	Type	Power Up Condition	Reference To
7	ENPLL	PLL enable; if 0 PLL is switched off	R/W	1	
6	RES	Reserved	R/W	0	
5	SELM[1]	Divide ratio select for input clock CLKP and CLKN	R/W	0	<a href="#">Table 4</a>
4	SELM[0]	Divide ratio select for input clock CLKP and CLKN	R/W	0	<a href="#">Table 4</a>
3	SELN[3]	Divide ratio select for pre-divider N (PLL clock)	R/W	1	<a href="#">Table 3</a>
2	SELN[2]	Divide ratio select for pre-divider N (PLL clock)	R/W	0	<a href="#">Table 3</a>
1	SELN[1]	Divide ratio select for pre-divider N (PLL clock)	R/W	0	<a href="#">Table 3</a>
0	SELN[0]	Divide ratio select for pre-divider N (PLL clock)	R/W	1	<a href="#">Table 3</a>

**Table 2. Divide Ratio Settings for Post-Divider P0 or P1**

Divide Ratio	SELP1[3] or SELP0[3]	SELP1[2] or SELP0[2]	SELP1[1] or SELP0[1]	SELP1[0] or SELP0[0]	Notes
1	0	0	0	0	
2	0	0	0	1	
4	0	0	1	0	
5	0	0	1	1	
8	0	1	0	0	
10	0	1	0	1	
16	0	1	1	0	
20	0	1	1	1	Default
32	1	0	0	0	
40	1	0	0	1	
80	1	0	1	0	

**Table 3. Divide Ratio Settings for Divider N**

Divide Ratio	SELN[3]	SELN[2]	SELN[1]	SELN[0]	Notes
32	1	0	0	0	
40	1	0	0	1	Default

**Table 4. Divide Ratio Settings for Divider M**

Divide Ratio	SELM[1]	SELM[0]	Notes
1	0	0	Default
2	0	1	
4	1	0	
8	1	1	

**Table 5. Phase Settings for Divide Ratio = 5, 10, 20, 40, 80**

Divide Ratio	With PH0[4:0] = 00000					Phase Lead (radian)	Notes
	PH1						
	[4]	[3]	[2]	[1]	[0]		
5	X	X	X	X	X	0	Phase setting not available
10	X	X	X	0	X	0	
	X	X	X	1	X	(2π/2)	
20	X	X	0	0	X	0	00000:Default
	X	X	0	1	X	(2π/4)	
	X	X	1	0	X	2(2π/4)	
	X	X	1	1	X	3(2π/4)	
40	X	0	0	0	X	0	
	X	0	0	1	X	(2π/8)	
	X	0	1	0	X	2(2π/8)	
	X	0	1	1	X	3(2π/8)	
	X	1	0	0	X	4(2π/8)	
	X	1	0	1	X	5(2π/8)	
	X	1	1	0	X	6(2π/8)	
	X	1	1	1	X	7(2π/8)	
80	0	0	0	0	X	0	
	0	0	0	1	X	(2π/16)	
	0	0	1	0	X	2(2π/16)	
	0	0	1	1	X	3(2π/16)	
	0	1	0	0	X	4(2π/16)	
	0	1	0	1	X	5(2π/16)	
	0	1	1	0	X	6(2π/16)	
	0	1	1	1	X	7(2π/16)	
	1	0	0	0	X	8(2π/16)	
	1	0	0	1	X	9(2π/16)	
	1	0	1	0	X	10(2π/16)	
	1	0	1	1	X	11(2π/16)	
	1	1	0	0	X	12(2π/16)	
	1	1	0	1	X	13(2π/16)	
	1	1	1	0	X	14(2π/16)	
	1	1	1	1	X	15(2π/16)	

**Table 6. Phase Settings for Divide Ratio = 1, 2, 4, 8, 16, 32**

Divide Ratio	With PH0[4:0] = 00000					Phase Lead (radian)	Notes
	PH1						
	[4]	[3]	[2]	[1]	[0]		
1	X	X	X	X	X	0	Phase setting not available
2	X	X	X	X	0	0	
	X	X	X	X	1	(2π/2)	
4	X	X	X	0	0	0	
	X	X	X	0	1	(2π/4)	
	X	X	X	1	0	2(2π/4)	
	X	X	X	1	1	3(2π/4)	
8	X	X	0	0	0	0	
	X	X	0	0	1	(2π/8)	
	X	X	0	1	0	2(2π/8)	
	X	X	0	1	1	3(2π/8)	
	X	X	1	0	0	4(2π/8)	
	X	X	1	0	1	5(2π/8)	
	X	X	1	1	0	6(2π/8)	
	X	X	1	1	1	7(2π/8)	
16	X	0	0	0	0	0	
	X	0	0	0	1	(2π/16)	
	X	0	0	1	0	2(2π/16)	
	X	0	0	1	1	3(2π/16)	
	X	0	1	0	0	4(2π/16)	
	X	0	1	0	1	5(2π/16)	
	X	0	1	1	0	6(2π/16)	
	X	0	1	1	1	7(2π/16)	
	X	1	0	0	0	8(2π/16)	
	X	1	0	0	1	9(2π/16)	
	X	1	0	1	0	10(2π/16)	
	X	1	0	1	1	11(2π/16)	
	X	1	1	0	0	12(2π/16)	
	X	1	1	0	1	13(2π/16)	
	X	1	1	1	0	14(2π/16)	
	X	1	1	1	1	15(2π/16)	

**Table 6. Phase Settings for Divide Ratio = 1, 2, 4, 8, 16, 32 (continued)**

Divide Ratio	With PH0[4:0] = 00000					Phase Lead (radian)	Notes
	PH1						
	[4]	[3]	[2]	[1]	[0]		
32	0	0	0	0	0	0	
	0	0	0	0	1	(2π/32)	
	0	0	0	1	0	2(2π/32)	
	0	0	0	1	1	3(2π/32)	
	0	0	1	0	0	4(2π/32)	
	0	0	1	0	1	5(2π/32)	
	0	0	1	1	0	6(2π/32)	
	0	0	1	1	1	7(2π/32)	
	0	1	0	0	0	8(2π/32)	
	0	1	0	0	1	9(2π/32)	
	0	1	0	1	0	10(2π/32)	
	0	1	0	1	1	11(2π/32)	
	0	1	1	0	0	12(2π/32)	
	0	1	1	0	1	13(2π/32)	
	0	1	1	1	0	14(2π/32)	
	0	1	1	1	1	15(2π/32)	
	1	0	0	0	0	16(2π/32)	
	1	0	0	0	1	17(2π/32)	
	1	0	0	1	0	18(2π/32)	
	1	0	0	1	1	19(2π/32)	
	1	0	1	0	0	20(2π/32)	
	1	0	1	0	1	21(2π/32)	
	1	0	1	1	0	22(2π/32)	
	1	0	1	1	1	23(2π/32)	
	1	1	0	0	0	24(2π/32)	
	1	1	0	0	1	25(2π/32)	
	1	1	0	1	0	26(2π/32)	
	1	1	0	1	1	27(2π/32)	
	1	1	1	0	0	28(2π/32)	
	1	1	1	0	1	29(2π/32)	
	1	1	1	1	0	30(2π/32)	
	1	1	1	1	1	31(2π/32)	

**Table 7. PLL Bandwidth Setting**

PLL Bandwidth <sup>(1)</sup> (kHz)	SELBW				C <sub>1</sub> (nF)	R (Ω)	C <sub>2</sub> (nF)	On-Chip Loop Filter ON/OFF	Notes
	[3]	[2]	[1]	[0]					
400	0	0	0	0	N/A	N/A	N/A	ON	Default
350	0	0	1	0	2.2	8660	0	OFF	
300	0	0	1	1	3.3	7500	0	OFF	
250	0	1	0	0	4.7	6200	0	OFF	
200	0	1	1	0	8.2	4990	0	OFF	
175	1	0	0	0	10	4300	0	OFF	
150	1	0	1	0	15	3740	0	OFF	
125	1	1	1	1	22	3090	0	OFF	
100	1	1	1	1	33	2490	0.24	OFF	
75	1	1	1	1	56	1870	0.82	OFF	
50	1	1	1	1	150	1210	2.70	OFF	
20	1	1	1	1	680	470	18	OFF	
10	1	1	1	1	3300	220	68	OFF	

(1) Refer to [Functional Block Diagram](#) for the external low pass filter architecture.

## FREQUENCY SETTINGS FOR SOME APPLICATIONS

PROTOCOL	APPLICATION								
	Output Clock MHz	Output Divider P0, P1	VCO Freq GHz	PLL Divider N (max f)	Ref Clock Divider M (max f)	Ref Clock Max Freq MHz	PLL Divider N (min f)	Ref Clock Divider M (min f)	Ref Clock Min Freq MHz
10G Ethernet (XAUI)	312.5	4	1.250	32	8	312.5	40	1	31.25
	156.25	8	1.250	32	8	312.5	40	1	31.25
	78.125	16	1.250	32	8	312.5	40	1	31.25
	62.5	20	1.250	32	8	312.5	40	1	31.25
1G Ethernet Serial ATA	250	5	1.250	40	8	250	40	1	31.25
	125	10	1.250	40	8	250	40	1	31.25
	62.5	20	1.250	40	8	250	40	1	31.25
10X FIBRE CHANNEL	159.375	8	1.275	32	8	318.75	40	1	31.875
	63.75	20	1.275	32	8	318.75	40	1	31.875
CPRI	245.76	5	1.229	40	8	245.78	40	1	30.72
	122.88	10	1.229	40	8	245.78	40	1	30.72
	61.44	20	1.229	40	8	245.78	40	1	30.72
	30.72	40	1.229	40	8	245.78	40	1	30.72
OBSAI	153.6	8	1.229	32	8	307.2	32	1	38.4
	76.8	16	1.229	32	8	307.2	32	1	38.4
PCI Express	250	5	1.250	40	8	250	40	1	31.25
Serial ATA	150	8	1.200	32	8	300	32	1	37.5
	75	16	1.200	32	8	300	32	1	37.5
SONET	622.08	2	1.244	32	8	311.04	40	1	31.104
	311.04	4	1.244	32	8	311.04	40	1	31.104
	155.52	8	1.244	32	8	311.04	40	1	31.104
	62.208	20	1.244	32	8	311.04	40	1	31.104

## REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

### Changes from Original (February 2007) to Revision A Page

- Added second specification condition for clock output skew parameter. .... [4](#)

### Changes from Revision A (March 2008) to Revision B Page

- Added Sentence to the Description: The serial interface is 1.8V tolerant only. .... [2](#)
- Changed  $V_{ILVDS}$  From: -0.3 to 4.0 To: -0.3 to  $V_{DD} + 0.6$  in the Abs Max table .... [3](#)
- Changed  $V_I$  From: -0.3 to 3.0 To: -0.3 to  $V_{DD} + 0.6$  in the Abs Max table .... [3](#)
- Added the THERMAL INFORMATION table .... [3](#)
- Changed the Test Conditions of  $V_{D,OUT}$  in the AC Electrical Characteristics table .... [4](#)
- Changed the description of SCL and SDA in the Pin Functions table .... [7](#)
- Added Note 1 to the FUNCTIONAL BLOCK DIAGRAM .... [8](#)
- Added the SDA/SCL Connections Recommendations section .... [12](#)

## PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">CDCL6010RGZR</a>	Active	Production	VQFN (RGZ)   48	2500   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	CDCL 6010
CDCL6010RGZR.A	Active	Production	VQFN (RGZ)   48	2500   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	CDCL 6010
<a href="#">CDCL6010RGZT</a>	Active	Production	VQFN (RGZ)   48	250   SMALL T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	CDCL 6010
CDCL6010RGZT.A	Active	Production	VQFN (RGZ)   48	250   SMALL T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	CDCL 6010
CDCL6010RGZTG4	Active	Production	VQFN (RGZ)   48	250   SMALL T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	CDCL 6010
CDCL6010RGZTG4.A	Active	Production	VQFN (RGZ)   48	250   SMALL T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	CDCL 6010

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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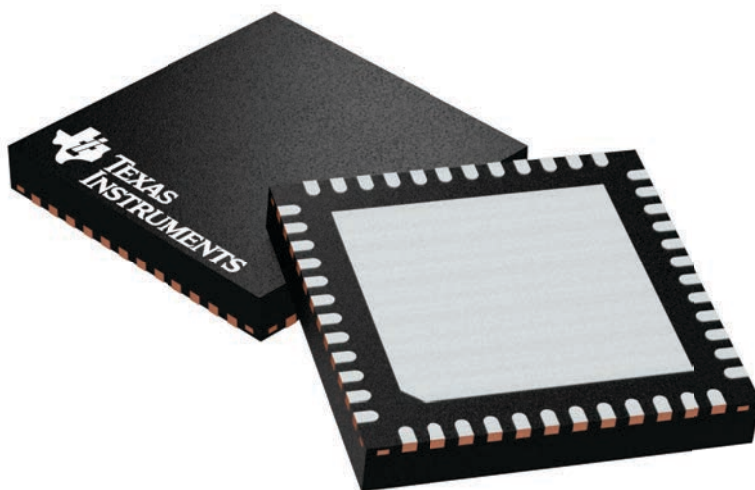
## GENERIC PACKAGE VIEW

**RGZ 48**

**VQFN - 1 mm max height**

7 x 7, 0.5 mm pitch

PLASTIC QUADFLAT PACK- NO LEAD



Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

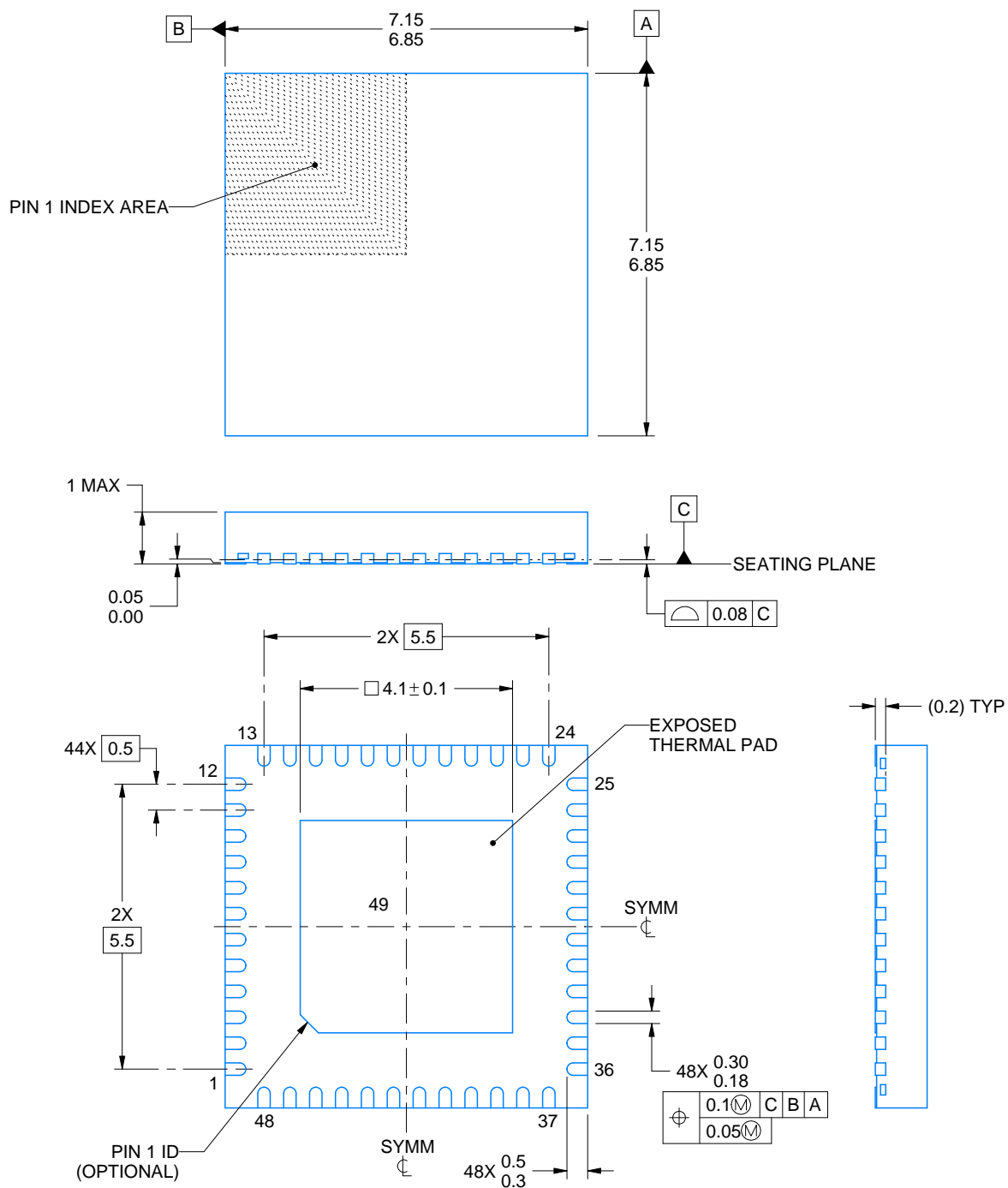
4224671/A

**RGZ0048B**

## PACKAGE OUTLINE

### VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



4218795/B 02/2017

NOTES:

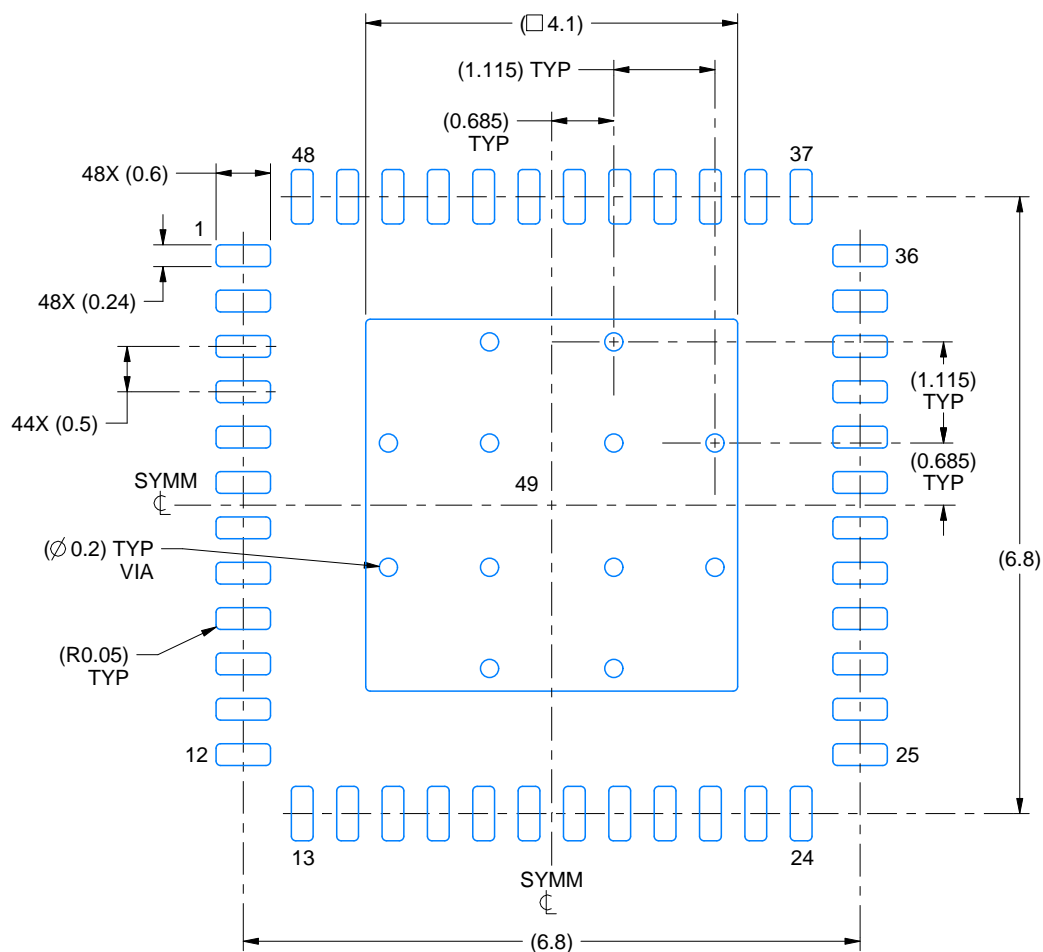
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

# EXAMPLE BOARD LAYOUT

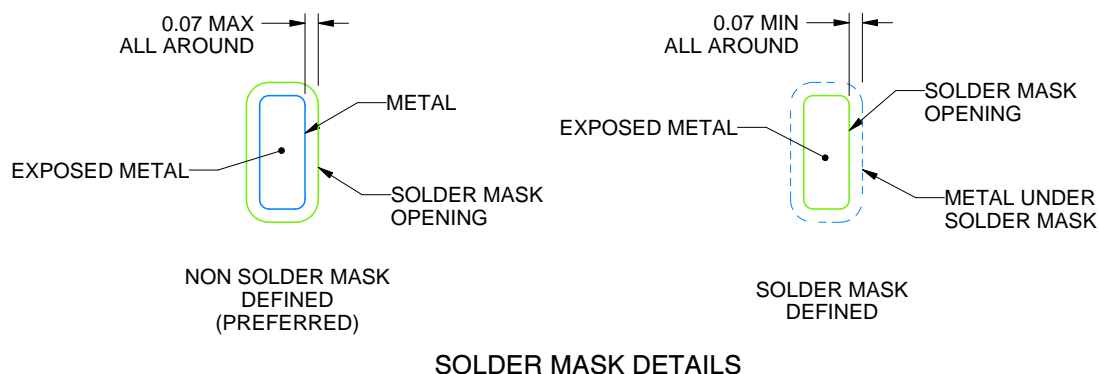
RGZ0048B

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:12X



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NOTES: (continued)

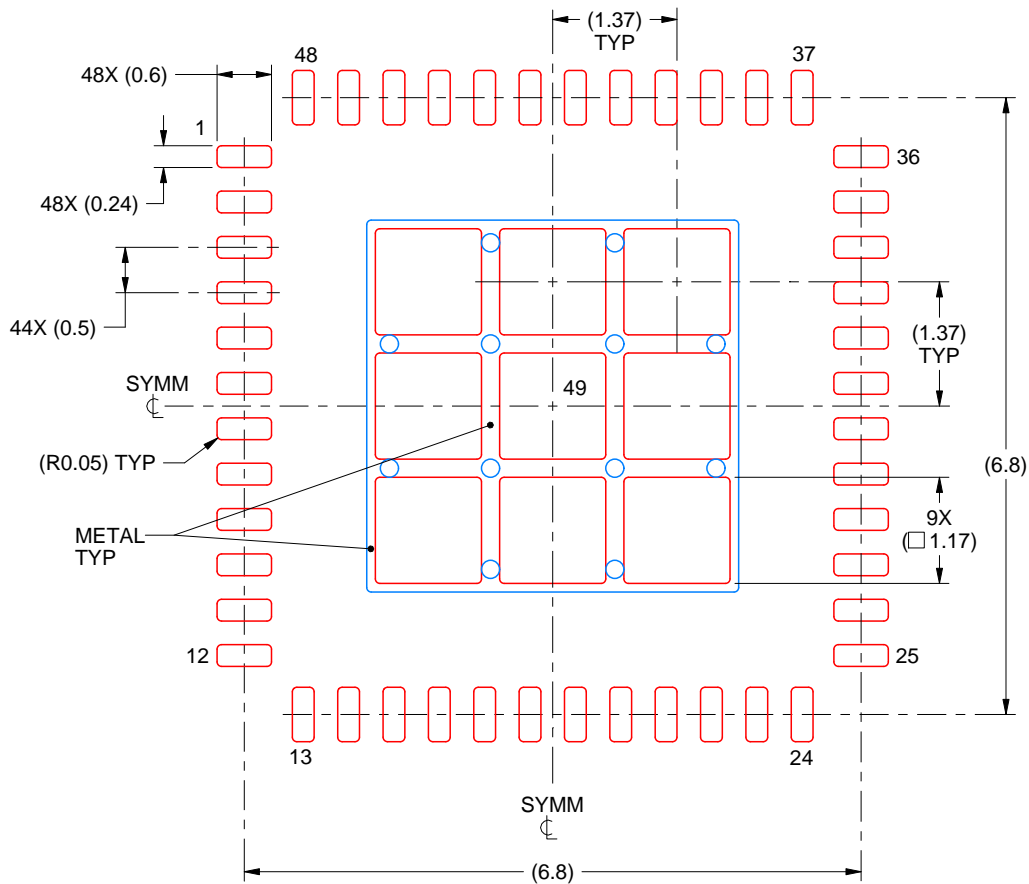
- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).
- Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

# EXAMPLE STENCIL DESIGN

RGZ0048B

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



## SOLDER PASTE EXAMPLE BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 49  
73% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE  
SCALE:12X

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NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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