CDCE6214-Q1 Ultra-Low Power Clock Generator With One PLL, Four Differential Outputs, Two Inputs, and Internal EEPROM

1 Features

- AEC-Q100 qualified for automotive applications
  - Temperature grade 2: –40°C to 105°C
- Functional Safety-Capable
  - Documentation available to aid functional safety system design
- Configurable high performance, low-power, frac-N PLL with RMS jitter with spurs (12kHz – 20MHz, F_{out} > 100MHz) as:
  - Integer mode:
    - Differential output: 350fs typical (typ.), 600fs (max.)
    - LVCMOS output: 1.05ps (typ.), 1.5ps (max.)
  - Fractional mode:
    - Differential output: 1.7ps (typ.), 2.1ps (max.)
    - LVCMOS output: 2.0ps (typ.), 4.0ps (max.)
- Supports PCIe Gen 1, 2, and 3 with SSC and Gen 1, 2, 3, 4, 5, 6, and 7 without SSC
- Typical power consumption: 65mA for 4-output channel, 23mA for 1-output channel
- Universal clock input
  - Differential AC-coupled or LVCMOS: 10MHz to 200MHz
  - Crystal: 10MHz to 50MHz
- Flexible output clock distribution
  - Four channel dividers: Up to five unique output frequencies from 24kHz to 328.125MHz
  - Combination of LVDS-like, LP-HCSL or LVCMOS outputs on OUT0 – OUT4 pins
  - Glitchless output divider switching and output channel synchronization
  - Individual output enable through GPIO and register
- Frequency margining options
  - DCO mode: frequency increment/decrement with 10ppb or less step-size
- Fully-integrated, configurable loop bandwidth: 100kHz to 1.6MHz
- Single or mixed supply for level translation: 1.8V, 2.5V, 3.3V
- Configurable GPIOs and flexible configuration options
  - I^2C-compatible interface: up to 400kHz
  - Integrated EEPROM with two pages and external select pin. In-situ programming allowed.
- Supports 100Ω systems
- Low electromagnetic emissions
- Small footprint: 24-pin VQFN (4mm × 4mm)

2 Applications

- PCIe Gen 1 - Gen 7 clocking
- Advanced driver assistance systems (ADAS) - sensor fusion
- Infotainment & cluster - automotive head unit - eAVB
- Data center & enterprise computing
- PC & notebooks
- Enterprise machine - multifunction printer
- Test & measurement - handheld equipment

3 Description

The CDCE6214-Q1 is a 4-channel, ultra-low power, medium grade jitter, clock generator for automotive application that can generate five independent clock outputs selectable between various modes of drivers. The input source can be a single-ended or differential input clock source, or a crystal. The CDCE6214-Q1 features a frac-N PLL to synthesize unrelated base frequency from any input frequency.

The CDCE6214-Q1 can be configured through the I^2C interface in fall-back mode only. In the absence of the serial interface, the GPIO pins can be used in pin mode to configure the product into distinctive configurations.

On-chip EEPROM can be used to change the configuration, which is pre-selectable through the pins. The device provides frequency margining options with glitch-free operation to support system design verification tests (DVT) and Ethernet Audio-Video Bridging (eAVB). Fine frequency margining is available on any output channel by steering the fractional feedback divider in DCO mode.

Internal power conditioning provides excellent power supply ripple rejection (PSRR), reducing the cost and complexity of the power delivery network. The analog and digital core blocks operate from either a 1.8V, 2.5V, or 3.3V ±5% supply, and output blocks operate from a 1.8V, 2.5V, or 3.3V ±5% supply.

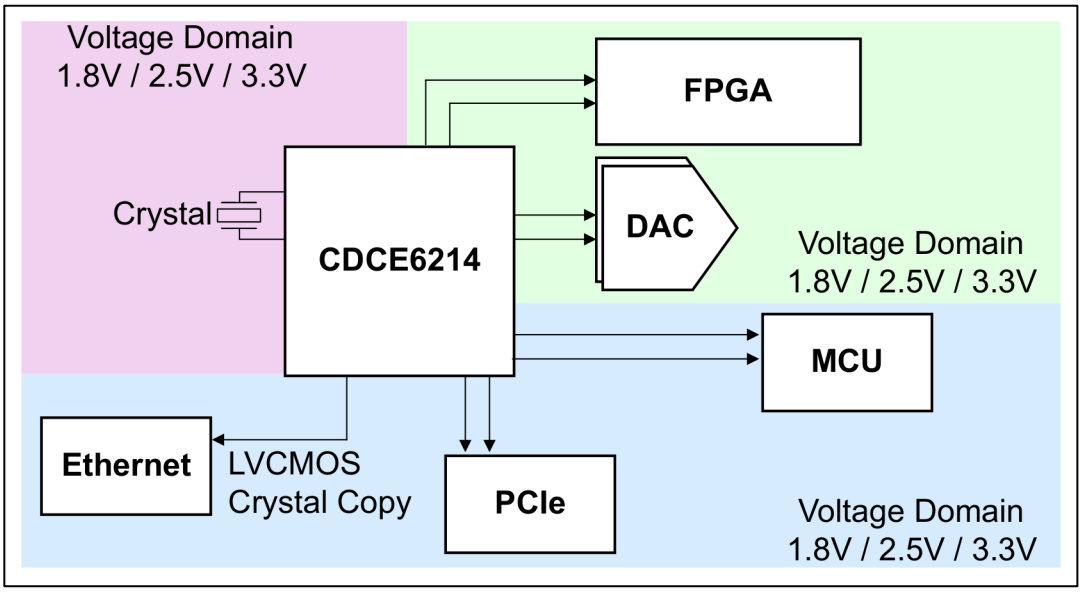
The CDCE6214-Q1 enables high-performance clock trees from a single reference at ultra-low power with a small footprint. The factory- and user-programmable EEPROM features make the CDCE6214-Q1 an easy-to-use, instant on clocking device with a low power consumption.

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

Table 3-1. Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
CDCE6214-Q1	RGE (VQFN, 24)	4.00mm × 4.00mm

(1) For more information, see Section 11.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Application Example CDCE6214-Q1

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4 Pin Configuration and Functions

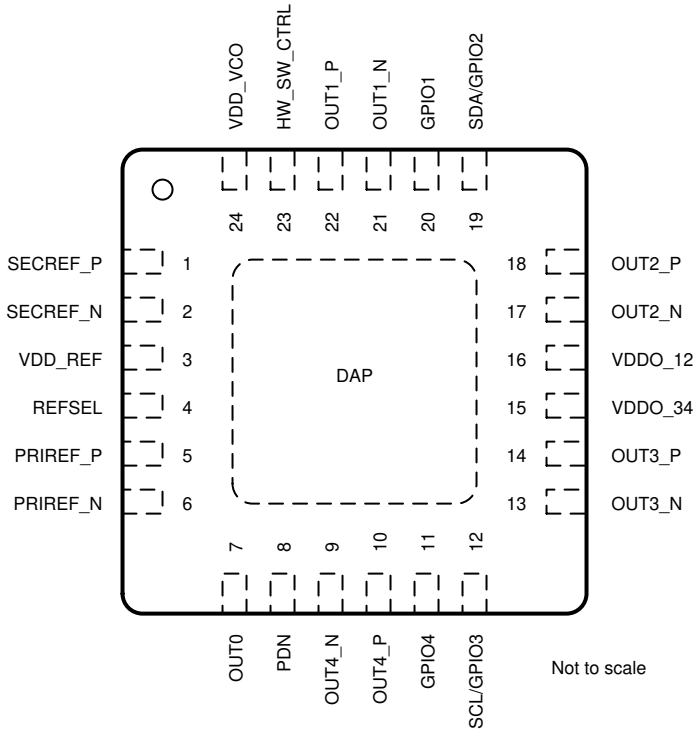


Figure 4-1. RGE Package24-Pin VQFNTop View

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Table 4-1. Pin Functions

PIN		Type[1]	DESCRIPTION
NAME	NO.		
POWER			
DAP	—	G	Die Attach Pad. The DAP is an electrical connection and provides a thermal dissipation path. For proper electrical and thermal performance of the device, the DAP must be connected to PCB ground plane.
VDD_REF	3	P	1.8V, 2.5V, or 3.3V Power Supply for Reference Input and Digital.
VDD_VCO	24	P	1.8V, 2.5V, or 3.3V Power Supply for PLL/VCO.
VDDO_12	16	P	1.8V, 2.5V, or 3.3V Power Supply for OUT1 and OUT2 channels
VDDO_34	15	P	1.8V, 2.5V, or 3.3V Power Supply for OUT0, OUT3, and OUT4 channels
INPUT BLOCK			
HW_SW_CTRL	23	I, R_{PUPD}	Manual selection pin for EEPROM pages (tri-state). Weak Pullup/Pulldown. R_{PU} = 50kΩ. R_{PD} = 50kΩ.
PRIREF_P	5	I	Primary reference clock. Accepts a differential or single-ended input. Input pins need AC-coupling capacitors and internally biased in differential mode. For LVCMOS, input must be provided on PRIREF_P and the non-driven input pin must be pulled down to ground. Internal biasing for differential mode is disabled in single-ended mode.
PRIREF_N	6	I	
REFSEL	4	I, R_{PUPD}	Manual selection pin of reference input (tri-state). Weak Pullup/Pulldown. R_{PU} = 50kΩ. R_{PD} = 50kΩ.
SECREF_P	1	I	Secondary reference clock. Accepts a differential or single-ended input or XTAL. Input pins need AC-coupling capacitors and internally biased in differential mode. For XTAL input, connect crystal between SECREF_P and SECREF_N pin. SECREF_P is XOUT, SECREF_N is XIN. This device do not need any power limiting resistor on XOUT. For LVCMOS input, input must be provided on SECREF_P, and the non-driven input pin must be pulled down to ground. Internal biasing for differential mode is disabled in single-ended and XTAL mode.
SECREF_N	2	I	
OUTPUT BLOCK			
OUT0	7	O	LVCMOS Output 0. Reference Input can be bypassed into this output. Output slew-rate configurable on all LVCMOS outputs.
OUT1_P	22	O	LVDS-like/LP-HCSL/LVCMOS Output Pair 1. Programmable driver with LVDS-like/LP-HCSL or 2x LVCMOS outputs.
OUT1_N	21	O	
OUT2_P	18	O	LVDS-like/LP-HCSL Output Pair 2. Programmable driver with LVDS-like/LP-HCSL outputs.
OUT2_N	17	O	
OUT3_P	14	O	LVDS-like/LP-HCSL Output Pair 3. Programmable driver with LVDS-like/LP-HCSL outputs.
OUT3_N	13	O	
OUT4_P	10	O	LVDS-like/LP-HCSL/LVCMOS Output Pair 4. Programmable driver with LVDS-like/LP-HCSL or 2x LVCMOS outputs.
OUT4_N	9	O	
DIGITAL CONTROL / INTERFACES			
GPIO1	20	I/O	STATUS output or GPIO1 input.
GPIO4	11	I/O	STATUS output or GPIO4 input.
PDN	8	I, R_{PU}	Device Power-down/RESET (active low) or SYNCN. Weak pullup resistor. R_{PU} = 50kΩ. Pullup resistor disabled in output mode.
SDA/GPIO2	19	I/O	I^2C Serial Data (bidirectional, open-drain) or GPIO2 input. Requires an external pullup resistor to VDD_REF in I^2C mode. I^2C address is initialized from on-chip EEPROM. Fail-safe Input.

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Table 4-1. Pin Functions (continued)

PIN		Type[1]	DESCRIPTION
NAME	NO.		
SCL/GPIO3	12	I	I^2C Serial Clock or GPIO3 input. Requires an external pullup resistor to VDD_REF in I^2C mode. Fail-safe Input.

(1) Type:

- G = Ground
- P = Power
- I = Input
- I/O = Input/Output
- O = Output
- I, RPUPD = Input with Resistive Pullup and Pulldown
- I, RPU = Input with Resistive Pullup
- I/O, RPU = Input/Output with Resistive Pullup

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5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
VDD_REF, VDD_VCO, VDDO_12, VDDO_34	Supply Voltage	-0.3	3.63	V
PRIREF_P, PRIREF_N, SECREF_P, SECREF_N	Input Voltage	-0.3	VDD_REF + 0.3	V
GPIO1, SDA/GPIO2, SCL/GPIO3, GPIO4, REFSEL, HW_SW_CTRL, PDN	Input Voltage	-0.3	VDD_REF + 0.3	V
OUT0, OUT1_P, OUT1_N, OUT2_P, OUT2_N, OUT3_P, OUT3_N, OUT4_P, OUT4_N(2)	Output Voltage	-0.3	VDDO_X(2) + 0.3	V
T_J	Junction Temperature		125	°C
T_{stg}	Storage temperature	-65	150	°C

(1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
(2) VDDO_X refers to the output supply for a specific output channel, where X denotes the channel index.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per AEC Q100-002, HBM ESD Classification Level 2(1)	2000	V
		Charged-device model (CDM), per AEC Q100-011 CDM ESD Classification Level C5	750	V

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

5.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
VDD_VCO	Core supply voltage	1.71	1.8, 2.5, 3.3	3.465	V
VDDO_12, VDDO_34	Output supply voltage	1.71	1.8, 2.5, 3.3	3.465	V
VDD_REF	Reference supply voltage	1.71	1.8, 2.5, 3.3	3.465	V
T_A	Ambient temperature	-40		105	°C
T_J	Junction temperature	-40		125	°C
T_{LOCK}	Continuous lock over temperature (without VCO calibration)			145	°C
t_{RAMP}	Maximum supply voltage ramp time(1)	0.1		30	ms

(1) VDD pin must monotonically reach 95% of the final value within supply ramp time. All VDD pins are tied together for this evaluation. For non-monotonic or slower power supply ramp, pulling down the PDN pin until VDD pins has reached 95% of the final value is recommended. PDN pin has a 50kΩ pullup resistor. When PDN pin can not be actively controlled, TI recommends to add a capacitor to GND on PDN pin to delay the release of reset.

5.4 Thermal Information

THERMAL METRIC(1)		CDCE6214Q1 TM RGE (VQFN) 24 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	32.5	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	32.5	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	12.2	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	2.0	°C/W

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THERMAL METRIC(1)		CDCE6214Q1 TM RGE (VQFN) 24 PINS	UNIT
ψ_{JT}	Junction-to-top characterization parameter	0.4	°C/W
ψ_{JB}	Junction-to-board characterization parameter	12.2	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application note.

5.5 EEPROM Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
n_{EEcyc}	EEPROM programming cycles	each word	10			cycles
t_{EEret}	EEPROM data retention		10			years

5.6 Reference Input, Single-Ended Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{IN_Ref}	Reference frequency		10		200	MHz
V_{IH}	Input high voltage	LVCMOS Input Buffer	0.8 × VDD_REF			V
V_{IL}	Input low voltage	LVCMOS Input Buffer			0.2 × VDD_REF	V
dV_{IN}/dT	Input slew rate	20% - 80%	1			V/ns
IDC	Input duty cycle		40		60	%
$I_{IN_LEAKAGE}$	Input leakage current		-100		100	µA
C_{IN_REF}	Input capacitance	at 25°C			5	pF

5.7 Reference Input, Differential Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{IN_Ref}	Reference frequency		10		200	MHz
V_{IN_DIFF}	Differential input voltage swing, peak-to-peak	VDD_REF = 2.5V/3.3V	0.4		1.6	V
V_{IN_DIFF}	Differential input voltage swing, peak-to-peak	VDD_REF = 1.8V	0.4		1.0	V
dV_{IN}/dT	Input slew rate	20% - 80%	1			V/ns
IDC	Input duty cycle		40		60	%
$I_{IN_LEAKAGE}$	Input leakage current		-100		100	µA
C_{IN_REF}	Input capacitance	at 25°C		5		pF

5.8 Reference Input, Crystal Mode Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C(1)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{IN_Xtal}	Crystal frequency	Fundamental mode	10		50	MHz
Z_{ESR}	Crystal equivalent series resistance	f_{XTAL} = 10MHz to 16MHz			60	Ω
Z_{ESR}	Crystal equivalent series resistance	f_{XTAL} = 16MHz to 30MHz			50	Ω
Z_{ESR}	Crystal equivalent series resistance	f_{XTAL} = 30MHz to 50MHz			30	Ω
C_L	Crystal load capacitance	Using on-chip load capacitance. A supported Crystal is within	5		12.8	pF
P_{XTAL}	Crystal tolerated drive power	A supported crystal tolerates up to			200	µW

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VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C(1)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
C_{XIN_LOAD}	On-Chip load capacitance	Programmable in typ. 200 fF steps	3		9.1	pF

(1) For details on configuring the XTAL Input, please refer to the *SNAA331: CDCI6214 and CDCE6214-Q1 design with crystal input* application note.

5.9 General-Purpose Input Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IH}	Input high voltage		0.8 × VDD_REF			V
V_{IL}	Input low voltage				0.2 × VDD_REF	V
I_{IH}	Input high level current	V_{IH} = VDD_REF, GPIO[1:4], PDN	-5		5	µA
I_{IL}	Input low level current	V_{IL} = GND, GPIO[2:3]	-5		5	µA
I_{IL}	Input low level current	V_{IL} = GND, GPIO[1], GPIO[4], PDN	-100		100	µA
dV_{IN}/dT	Input slew rate	20% - 80%	0.5			V/ns
T_{PULSE_WIDTH}	Pulse width for correct operation		10			ns
R_{PU}	Pullup Resistance	Pins PDN, GPIO[1], GPIO[4]	30	55	80	kΩ
C_{IN}	Pin Capacitance				10	pF

5.10 Triple Level Input Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IH}	Input high voltage		0.8 × VDD_REF			V
V_{IM}	Input mid voltage	Float pin	0.41 × VDD_REF	0.5 × VDD_REF	0.58 × VDD_REF	V
V_{IL}	Input low voltage				0.2 × VDD_REF	V
I_{IH}	Input high level current	V_{IH} = VDD_REF	20	50	100	µA
I_{IL}	Input low level current	V_{IL} = GND	-100	-50	-20	µA

5.11 Logic Output Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
VOH	Output high voltage		0.8 × VDD_REF			V
VOL	Output low voltage				0.2 × VDD_REF	V

5.12 Phase Locked Loop Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{PFD}	Phase Detector Frequency	Integer and Fractional PLL mode	1		100	MHz
f_{VCO}	Voltage Controlled Oscillator Frequency		2335		2625	MHz
f_{BW}	Configurable closed-loop PLL Bandwidth	REF = 25MHz	100		1600	kHz
K_{VCO}	Voltage-Controlled Oscillator Gain	f_{VCO} = 2.4GHz		140		MHz/V
K_{VCO}	Voltage-Controlled Oscillator Gain	f_{VCO} = 2.5GHz		175		MHz/V
$\lvert\Delta T_{CL}\rvert$	Allowable Temperature Drift for Continuous Lock(1)	dT/dt ≤ 20K / min			145	ºC

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VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{MAX-ERROR}$	Maximum frequency error with frac-N PLL				0.1	ppm

(1) The maximum allowable temperature drift for continuous lock: how far the temperature can drift in either direction from the previous value, when the On-Chip VCO is calibrated while the PLL stays in lock throughout the temperature drift. The internal VCO calibration takes place: at device start-up, when the device is reset using the RESET pin and when REGISTER bit is changed. This implies the device works over the entire frequency range, but if the temperature drifts more than the 'maximum allowable temperature drift for continuous lock', then re-calibrating the VCO, using the appropriate REGISTER bit, is necessary to verify that the PLL stays in lock. Regardless of what temperature the part is initially calibrated at, the temperature can never drift outside the ambient temperature range of -40°C to 105°C.

5.13 Closed-Loop Output Jitter Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{RJ_CL}	RMS Phase Jitter	RMS jitter with spurs from 12kHz to 20MHz , Input Crystal = 25MHz, Differential OUTx > 100MHz, int-PLL		350	600	fs
t_{RJ_CL}	RMS Phase Jitter(1)	RMS jitter with spurs from 12kHz to 20MHz, Input Crystal = 25MHz, Differential OUTx > 100MHz, frac-PLL		1600	2100	fs
$J_{PCIe3-ccSSC_off}$	PCIe Gen 3 Common Clock jitter, SSC is off	(2)		145	1000	fs
$J_{PCIe3-ccSSC_on}$	PCIe Gen 3 Common Clock jitter, SSC = -0.5%	(3)		627	1000	fs
$J_{PCIe3-SRNS}$	PCIe Gen 3 SRNS jitter	(2)		112	1000	fs
$J_{PCIe3-SRIS}$	PCIe Gen 3 SRIS jitter, SSC = -0.25%	(4)		1286	2000	fs
$J_{PCIe4-ccSSC_off}$	PCIe Gen 4 Common Clock jitter, SSC is off	(2)		145	500	fs
$J_{PCIe4-SRNS}$	PCIe Gen 4 SRNS jitter	(2)		112	500	fs
$J_{PCIe5-ccSSC_off}$	PCIe Gen 5 Common Clock jitter, SSC is off	(2)		62	150	fs
$J_{PCIe5-SRNS}$	PCIe Gen 5 SRNS jitter	(2)		47	150	fs
$J_{PCIe6-ccSSC_off}$	PCIe Gen 6 Common Clock jitter, SSC is off	(2)		37	100	fs
$J_{PCIe6-SRNS}$	PCIe Gen 6 SRNS jitter	(2)		34	100	fs
$J_{PCIe7-ccSSC_off}$	PCIe Gen 7 Common Clock jitter, SSC is off	(2)		37	67	fs
$J_{PCIe7-SRNS}$	PCIe Gen 7 SRNS jitter	(2)		24	67	fs

(1) F_{IN} = 25MHz, F_{OUT}= 161.1328MHz, F_{PFD} = 25MHz, RMS Noise = 1.83ps. F_{IN} = 25MHz, F_{OUT}= 161.1328MHz, F_{PFD} = 50MHz, RMS Noise = 1.33ps. F_{IN} = 25MHz, F_{OUT}= 148.5MHz, F_{PFD} = 25MHz, RMS Noise = 1.74ps. F_{IN} = 25MHz, F_{OUT}= 148.5MHz, F_{PFD} = 50MHz, RMS Noise = 1.43ps. F_{IN} = 25MHz, F_{OUT}= 148.3516MHz, F_{PFD} = 25MHz, RMS Noise = 1.6ps. F_{IN} = 25MHz, F_{OUT}= 148.3516MHz, F_{PFD} = 50MHz, RMS Noise = 1.5ps. F_{IN} = 25MHz, F_{OUT}= 106.5MHz, F_{PFD} = 25MHz, RMS Noise = 0.8ps. F_{IN} = 25MHz, F_{OUT}= 106.5MHz, F_{PFD} = 50MHz, RMS Noise = 1.3ps.
(2) Tested using PCIe recommended register settings for no SSC, found in Table 8-1.
(3) Tested using PCIe recommended register settings for SSC for Common Clock architectures, found in Table 8-2.
(4) Tested using PCIe recommended register settings for SSC for Separate Reference architectures, found in Table 8-3.

5.14 Input and Output Isolation

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$P_{ISOLATION}$	Reference input isolation	Crosstalk between reference inputs, PRIREF = 27MHz LVCMOS, SECREF = 25MHz XTAL		-64		dB
$P_{ISOLATION}$	Reference input isolation	Crosstalk between reference inputs, PRIREF = 100MHz LVDS, SECREF = 25MHz LVCMOS		-72		dB
$P_{ISOLATION}$	Clock output isolation	Crosstalk between clock outputs, OUT1 = 100MHz LP-HCSL, OUT2 = 156.25MHz LVDS, PFD = 25MHz, int-PLL		-65		dB

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VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$P_{ISOLATION}$	Clock output isolation	Crosstalk between clock outputs, OUT1 = 156.25MHz LVDS, OUT0 = 25MHz LVCMOS		-42		dB

5.15 Buffer Mode Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{RJ_ADD}	Additive RMS Phase Jitter, System Level	int. Range from 10kHz to 20MHz , REF = HCSL 100MHz with 0.5V/ns, OUTx = 100MHz LP-HCSL			350	fs
$t_{PROP, LVCMOS}$	Input-to-output propagation delay	REF = LVCMOS 25MHz, OUTx = 25MHz LVCMOS		1		ns
$t_{PROP, Differential}$	Input-to-output propagation delay(1)	REF = AC-LVDS 100MHz, OUTx = 100MHz. Measured on OUT0		2.3		ns
$t_{PROP-VARIATION}$	Input-to-output delay variation in ZDB mode	ZDB mode, LVCMOS input = LVCMOS output = 25MHz, PLL BW = 300kHz to 900kHz across temperature	-400		400	ps

(1) OUT1/OUT4 and OUT2/OUT3 are matched pair-wise. OUT1/OUT4 has LVCMOS buffer while OUT2/OUT3 do not have LVCMOS buffer. There is an additional skew 150ps - 250ps between OUT1/OUT4 and OUT2/OUT3.

5.16 PCIe Spread Spectrum Generator

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{SSC-RATE}$	SSC modulation rate	OUTx = 100MHz	30	31.5	33	kHz
$P_{AMPL-RED}$	SSC amplitude reduction	OUTx = 100MHz, -0.25% Down spread		6.8		dB
$P_{AMPL-RED}$	SSC amplitude reduction	OUTx = 100MHz, -0.50% Down spread		9.9		dB
$f_{SSC-STEP}$	Down and Center spread SSC step size	OUTx = 100MHz		0.25		%
$t_{SSC_FREQ_DEVIATION}$	Down spread minimum/maximum deviation	OUTx = 100MHz. F_{PFD} = 25MHz, 50MHz, 100MHz	-0.5		0	%
$t_{SSC_FREQ_DEVIATION}$	Center spread minimum/maximum deviation	OUTx = 100MHz. F_{PFD} = 25MHz, 50MHz, 100MHz	-0.5		0.5	%

5.17 LVCMOS Output Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{O_LVCMOS}	Output frequency	2pF to GND, normal mode	0.024		200	MHz
V_{OH_LVCMOS}	Output high voltage	I_{OH} = 1mA, VDDO_x is corresponding supply voltage.	0.8 × VDDO_x			V
V_{OL_LVCMOS}	Output low voltage	I_{OL} = 1mA, VDDO_x is corresponding supply voltage.			0.2 × VDDO_x	V
I_{OH}	Output high current	Vout = 0.8 × VDDO_x, VDDO_x = 1.8V		-6		mA
I_{OH}	Output high current	Vout = 0.8 × VDDO_x, VDDO_x = 2.5V		-8.5		mA
I_{OH}	Output high current	Vout = 0.8 × VDDO_x, VDDO_x = 3.3V		-11.2		mA
I_{OL}	Output low current	Vout = 0.2 × VDDO_x, VDDO_x = 1.8V		6		mA
I_{OL}	Output low current	Vout = 0.2 × VDDO_x, VDDO_x = 2.5V		8.5		mA
I_{OL}	Output low current	Vout = 0.2 × VDDO_x, VDDO_x = 3.3V		11.2		mA
$T_{RISE-FALL}$	Output rise/fall time	20/80%, C_L= 5pF, normal mode	300	500	700	ps
$T_{RISE-FALL}$	Output rise/fall time	20/80%, C_L= 5pF, slow mode, measured on OUT0		1000		ps
T_{SKEW}	Output-to-output skew(1)	LVCMOS-to-LVCMOS outputs, same divide value		100		ps
T_{SKEW}	Output-to-output skew(1)	LVCMOS-to-Differential outputs, same divide value		400		ps

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VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
ODC	Output duty cycle	Not in PLL bypass mode	45		55	%
R_{ON_LVCMOS}	Output impedance	Normal mode	45	60	75	Ω
R_{ON_LVCMOS}	Output impedance	Slow mode	50	65	85	Ω

(1) OUT1/OUT4 and OUT2/OUT3 are matched pair-wise. OUT1/OUT4 has LVCMOS buffer while OUT2/OUT3 do not have LVCMOS buffer. OUT1/OUT4 is matched within $T_{OUT-SKEW}$. OUT2/OUT3 is matched within $T_{OUT-SKEW}$.

5.18 LP-HCSL Output Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{O_HCSL}	Output frequency		0.024		328.125	MHz
V_{OH}	Output high voltage(3)		660		850	mV
V_{OL}	Output low voltage		-150		150	mV
Z_{DIFF}	Differential Output Impedance(3)		90	100	110	Ω
V_{CROSS}	Absolute crossing point	12-in, 100Ω ±10% diff. trace with 2pF±5%/pin in FR4.	250		550	mV
ΔV_{CROSS}	Relative crossing point variation	With respect to average crossing point			140	mV
dV/dt	Slew rate for rising and falling edge	Differential, at V_{CROSS} +/-150mV, f_{O_HCSL}=100MHz (1)	1		4	V/ns
ΔdV/dt	Slew rate matching	Single-ended, at V_{CROSS} +/-75mV, f_{O_HCSL}=100 MHz (1)			20	%
Vrb	Output ringback voltage	Measured on differential output at 100MHz and specifies minimum voltage from zero crossing	-100		100	mV
Tstable	Time elapsed until ringback	Minimum time until ringback is allowed	500			ps
ODC	Output duty cycle	Not in PLL bypass mode	45		55	%
$T_{OUT-SKEW}$	Output skew(2)	Same divide value, LP-HCSL to LP-HCSL		100		ps

(1) PCIe test load slew rate
(2) OUT1/OUT4 and OUT2/OUT3 are matched pair-wise. OUT1/OUT4 has LVCMOS buffer while OUT2/OUT3 do not have LVCMOS buffer. OUT1/OUT4 is matched within $T_{OUT-SKEW}$. OUT2/OUT3 is matched within $T_{OUT-SKEW}$. There is an additional skew 150ps - 250ps between OUT1/OUT4 and OUT2/OUT3.
(3) Differential Output characteristic is trimmed in factory and trim settings are stored in EEPROM. Parameter not valid in Fall-back mode.

5.19 LVDS Output Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{O_PRG_AC}$	Output frequency		0.024		328.125	MHz
V_{CM}	Output common mode(1)	VDDO_X = 2.5V, 3.3V	1.025	1.2	1.375	V
V_{CM}	Output common mode(1)	VDDO_X = 1.8V	0.85	0.95	1.05	V
V_{OD}	Differential output voltage(1)	VDDO_X = 1.8V (F_{out} < 200MHz), 2.5V, 3.3V.	0.25	0.30	0.45	V
V_{OD}	Differential output voltage(1)	VDDO_X = 1.8V & F_{out} > 200MHz	0.22	0.30	0.45	V
t_{RF}	Output rise/fall times	LVDS (20% to 80%)	450	650	900	ps
ODC	Output duty cycle	Not in PLL bypass mode	45		55	%
$T_{OUT-SKEW}$	Output skew(2)	Same divide value, LVDS to LVDS output		100		ps

(1) Output Common Mode voltage and Differential output swing is dependent upon register settings DIFFBUF_IBIAS_TRIM, LVDS_CMTRIM_DEC and LVDS_CMTRIM_INC. Parameters defined for DIFFBUF_IBIAS_TRIM=6h, LVDS_CMTRIM_DEC=0h and LVDS_CMTRIM_INC=0h. Output Common Mode tested at DC.
(2) OUT1/OUT4 and OUT2/OUT3 are matched pair-wise. OUT1/OUT4 has LVCMOS buffer while OUT2/OUT3 do not have LVCMOS buffer. OUT1/OUT4 is matched within $T_{OUT-SKEW}$. OUT2/OUT3 is matched within $T_{OUT-SKEW}$. There is an additional skew 150ps- 250ps between OUT1/OUT4 and OUT2/OUT3.

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5.20 Output Synchronization Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ±5%, 2.5V ±5%, 3.3V ±5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{SU_SYNC}	Setup time SYNC pulse	With respect to PLL reference rising edge at 100MHz with R=1	3			ns
t_{H_SYNC}	Hold time SYNC pulse	With respect to PLL reference rising edge at 100MHz with R=1			3	ns
t_{PWH_SYNC}	High pulse width for SYNC	With R = 1, at least 2 PFD periods + 24 feedback pre-scaler periods	60			ns
t_{PWL_SYNC}	Low pulse width for SYNC	With R = 1, at least 1 PFD period	6			ns
t_{EN}	Individual output enable time(1)	Tri-state to first valid rising edge			4	nCK
t_{DIS}	Individual output disable time(1)	Last valid falling edge to tri-state			4	nCK

(1) Output clock cycles of respective output channel. Global output enable handled by digital logic, additional propagation is added.

5.21 Power-On Reset Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{THRESHOLD}$	POR threshold voltage(1)		0.875		1.275	V
$t_{STARTUP}$	Start-up time	Start-up time after VDD reaches 95% to the time outputs are toggling with correct frequency (input = crystal or external clock)		9		ms
t_{VDD}	Power supply ramp time(2)	Timing requirement for any VDD pin while PDN=LOW	0.1		30	ms

(1) POR threshold voltage is the power supply voltage at which the internal reset is deasserted. The threshold voltage is qualified internally with PDN.
(2) VDD pin just monotonically reach 95% of the final value within supply ramp time. Parameters specified by characterization. All VDD pins are tied together for this evaluation. For non-monotonic or slower power supply ramp, pulling down the PDN pin until VDD pins has reached 95% of the final value is recommended. The PDN pin has a 50kΩ pullup resistor. When PDN pin can not be actively controlled, TI recommends to add a capacitor to GND on PDN pin to delay the release of reset.

5.22 I²C-Compatible Serial Interface Characteristics

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IH}	Input Voltage, Logic High		0.7 × VDD_REF			V
V_{IL}	Input Voltage, Logic Low				0.3 × VDD_REF	V
I_{IH}	Input Leakage Current	VDD_REF ± 10%	-5		5	µA
V_{OL}	Low Level Output Voltage	At 3mA sink current			0.4	V
C_{IN}	Input Capacitance				10	pF
C_{OUT}	Output Capacitance	Maximum bus capacitance per pin			400	pF

5.23 Timing Requirements, I²C-Compatible Serial Interface

VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PW_G}	Pulse Width of Suppressed Glitches				50	ns
f_{SCL}	SCL Clock Frequency	Standard		100		kHz
f_{SCL}	SCL Clock Frequency	Fast-mode		400		kHz
t_{SU_STA}	Setup Time Start Condition	SCL=V_{IH} before SDA=V_{IL}		0.6		µs
t_{H_STA}	Hold Time Start Condition	SCL=V_{IL} after SCL=V_{IL} After this time, the first clock edge is generated.		0.6		µs
t_{SU_SDA}	Setup Time Data	SDA valid after SCL=V_{IL}, f_{SCL}=100kHz	250			ns

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VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{SU_SDA}	Setup Time Data	SDA valid after SCL=V_{IL}, f_{SCL}=400kHz	100			ns
t_{H_SDA}	Hold Time Data(1)	SDA valid before SCL=V_{IH}	0(2)		(3)	µs
t_{VD_SDA}	Valid Data or Acknowledge Time	f_{SCL}=100kHz(3)			3.45	µs
t_{VD_SDA}	Valid Data or Acknowledge Time	f_{SCL}=400kHz(2)			0.9	µs
t_{PWH_SCL}	Pulse Width High, SCL	f_{SCL}=100kHz	4.0			µs
t_{PWH_SCL}	Pulse Width High, SCL	f_{SCL}=400kHz	0.6			µs
t_{PWL_SCL}	Pulse Width Low, SCL	f_{SCL}=100kHz	4.7			µs
t_{PWL_SCL}	Pulse Width Low, SCL	f_{SCL}=400kHz	1.3			µs
t_{IR}	Input Rise Time				300	ns
t_{IF}	Input Fall Time				300	ns
t_{OF}	Output Fall Time	10pF ≤ C_{OUT} ≤ 400 pF			250	ns
t_{SU_STOP}	Setup Time Stop Condition			0.6		µs
t_{BUS}	Bus-Free Time	Time between a Stop and a Start condition		1.3		µs

(1) t_{H_SDA} is the data hold time that is measured from the falling edge of SCL, applies to data in transmission and the acknowledge.
(2) A device must internally provide a hold time of at least 300ns for the SDA signal (with respect to the $V_{IH(min)}$ of the SCL signal) to bridge the undefined region of the falling edge of SCL.
(3) The maximum t_{H_SDA} can be 3.45µs and 0.9µs for Standard-mode and Fast-mode, but must be less than the maximum of t_{VD_SDA} by a transition time. This maximum must only be met if the device does not stretch the LOW period (t_{PWL_SCL}) of the SCL signal. If the clock stretches the SCL, the data must be valid by the setup time before the I^2C controller releases the clock.

5.24 Power Supply Characteristics

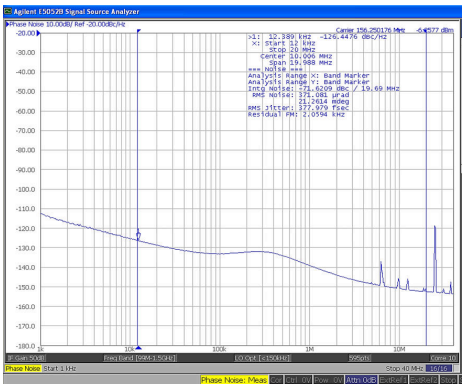
VDD_VCO, VDDO_12, VDDO_34, VDD_REF = 1.8V ± 5%, 2.5V ± 5%, 3.3V ± 5% and T_A = -40°C to 105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{DD_REF}	VDD_REF supply current	25MHz XTAL, DBL ON		8		mA
I_{DD_VCO}	VCO and PLL current	f_{VCO}=2400MHz, PSA = PSB = 4 and N-divider = 48		14		mA
I_{DD_OUT}	Output Channel Current	IOD=6, LP-HCSL, 100MHz on OUT3 and OUT4, 25MHz on OUT0		22		mA
I_{DD_OUT}	Output Channel Current	IOD = 6, LP-HCSL, 100MHz on OUT1 and OUT2		17.5		mA
I_{DD_PDN}	Power down current	Using reset pin / bits		2.8	5	mA
I_{DD_TYP}	Typical current	4x 100MHz LVDS case using crystal input and doubler, SSC off		50	70	mA
I_{DD_TYP}	Typical current	4x 100MHz LP-HCSL case using crystal input and doubler, SSC off		65	90	mA
L_{PSNR}	Power supply noise rejection	OUTx = 100MHz differential, on one of VDDx injected sine wave at f_{INJ} = 100kHz		-61		dB
L_{PSNR}	Power supply noise rejection	OUTx = 100MHz differential, on one of VDDx injected sine wave at f_{INJ} = 1MHz		-57		dB

5.25 Typical Characteristics

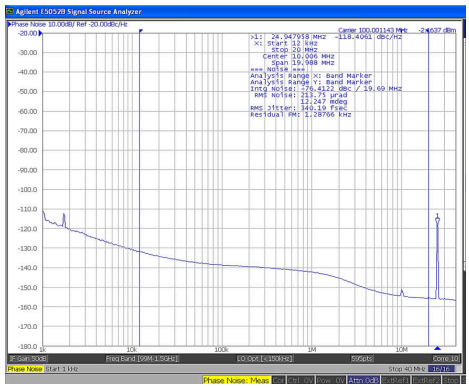
Measured at room temperature

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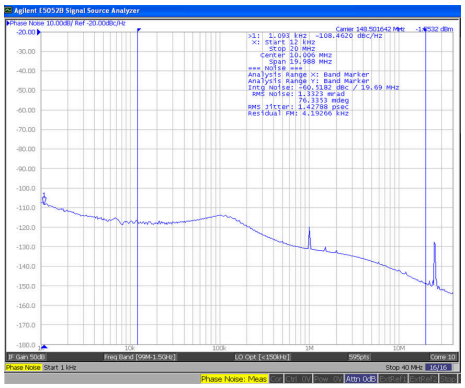
Reference: Crystal Input 25MHz | Closed-Loop Phase Noise from 2.5GHz VCO | 156.25MHz LVDS

Figure 5-1. 156.25MHz LVDS Output



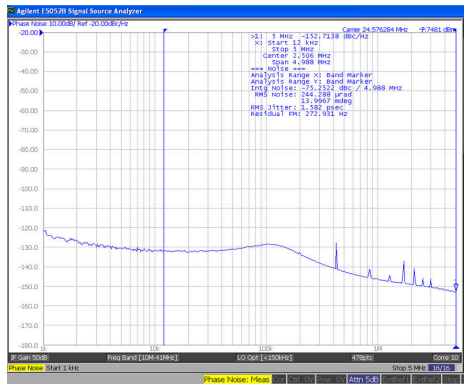
Reference: Crystal Input 25MHz | Closed-Loop Phase Noise from 2.4GHz VCO | 100MHz LP-HCSL

Figure 5-2. 100MHz LP-HCSL Output



Reference: Crystal Input 25MHz | Closed-Loop Phase Noise from 2.376GHz VCO | 148.5MHz LVDS

Figure 5-3. 148.5MHz LVDS Output



Reference: Crystal Input 25MHz | Closed-Loop Phase Noise from 2.4576GHz VCO | 24.576MHz LVCMOS

Figure 5-4. 24.576MHz LVCMOS Output

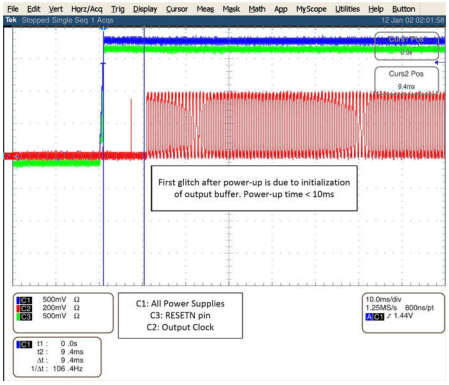


Figure 5-5. All Power Supply = 1.8V, VDD Ramp Time = 1ms

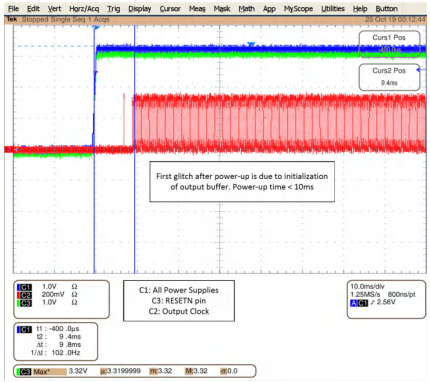


Figure 5-6. All Power Supply = 3.3V, VDD Ramp Time = 1ms

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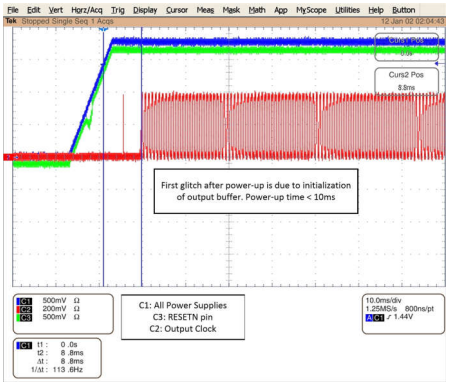


Figure 5-7. All Power Supply = 1.8V, VDD Ramp Time = 10ms

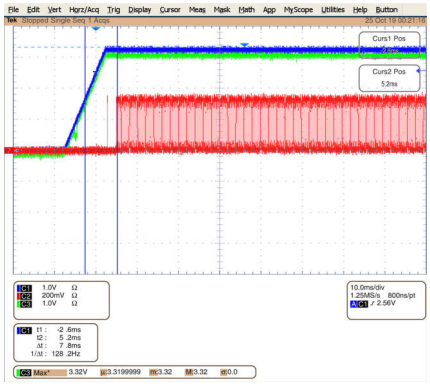


Figure 5-8. All Power Supply = 3.3V, VDD Ramp Time = 10ms

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6 Parameter Measurement Information

6.1 Reference Inputs

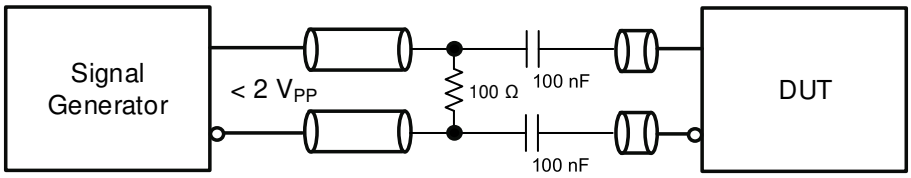


Figure 6-1. Differential AC-Coupled Input

6.2 Outputs

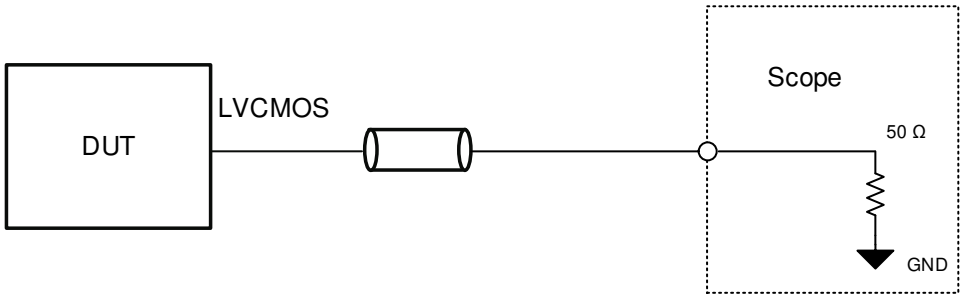


Figure 6-2. LVCMOS Output Test Configuration

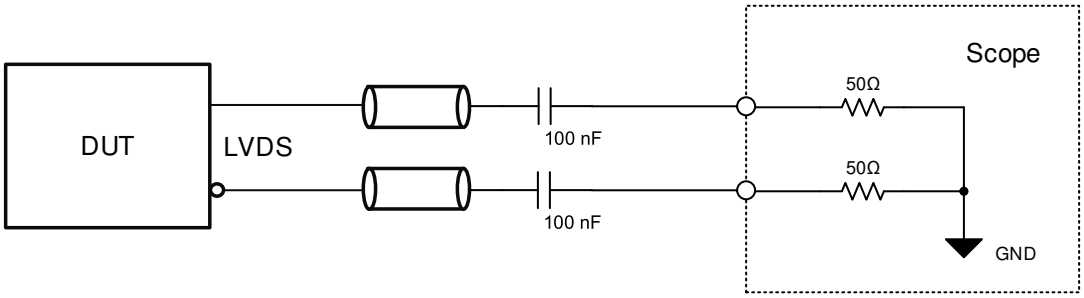


Figure 6-3. LVDS Output Test Configuration, AC-Coupled

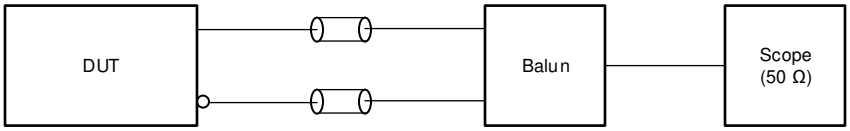


Figure 6-4. LP-HCSL Test Configuration, DC-Coupled

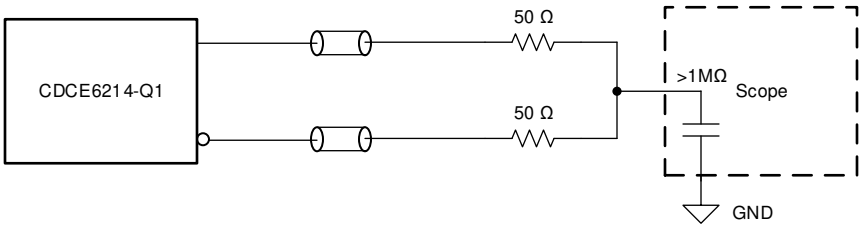


Figure 6-5. LVDS Common Mode Voltage, DC-Coupled

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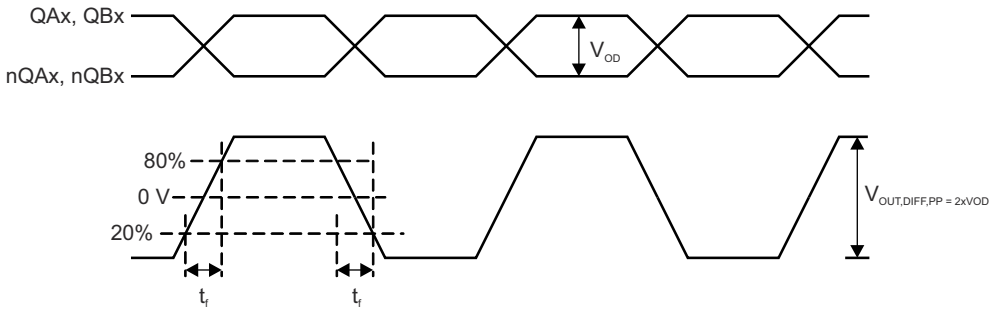


Figure 6-6. Differential Output Voltage and Rise/Fall Time

6.3 Serial Interface

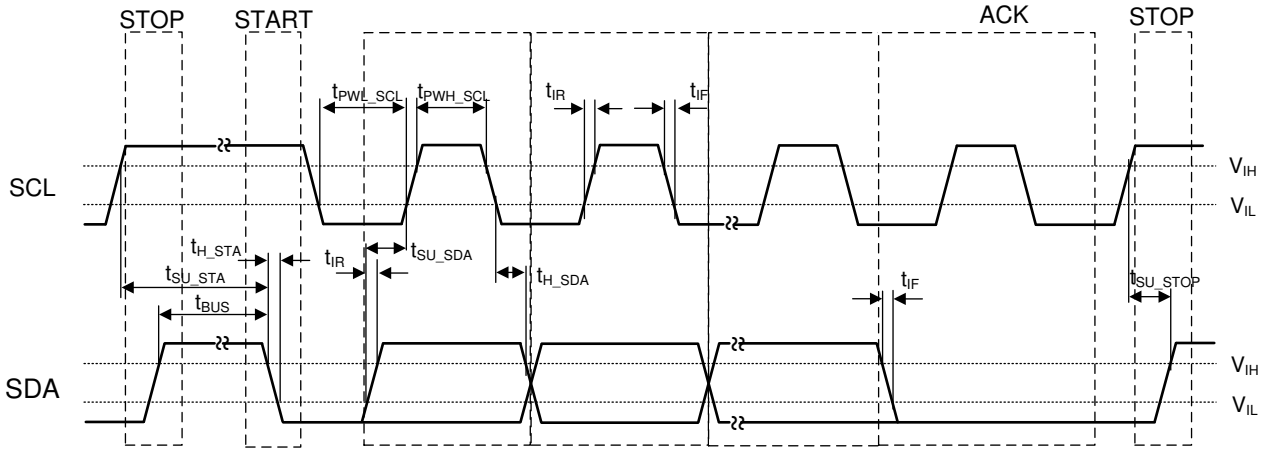


Figure 6-7. I²C Timing

6.4 PSNR Test

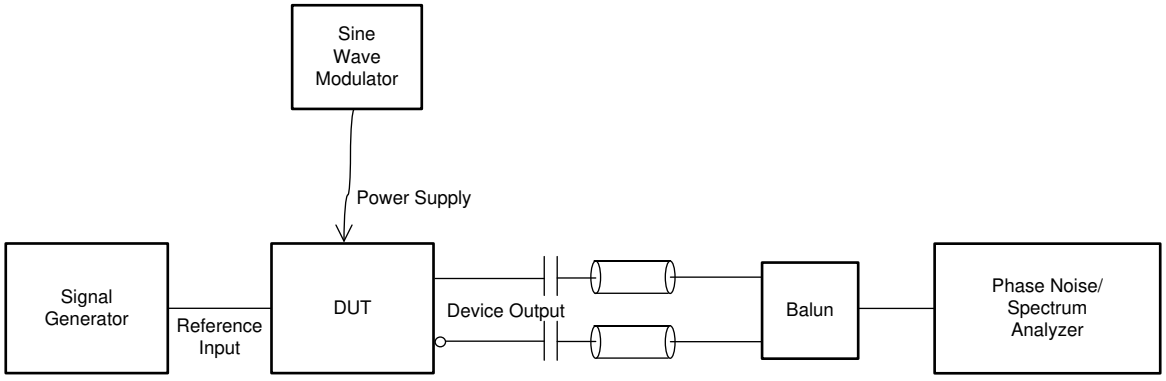


Figure 6-8. PSNR Test Configuration

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6.5 Clock Interfacing and Termination

6.5.1 Reference Input

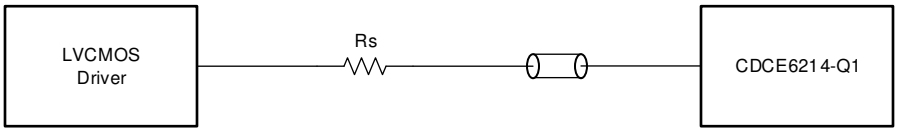


Figure 6-9. Single-Ended LVCMOS to Reference

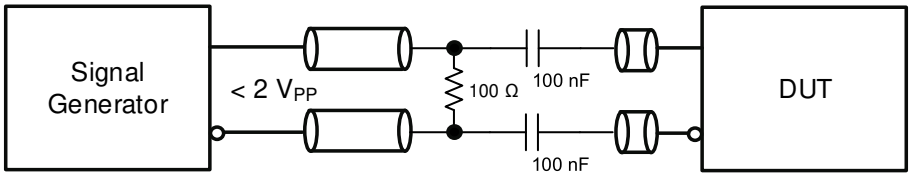


Figure 6-10. Differential Input to Reference

6.5.2 Outputs

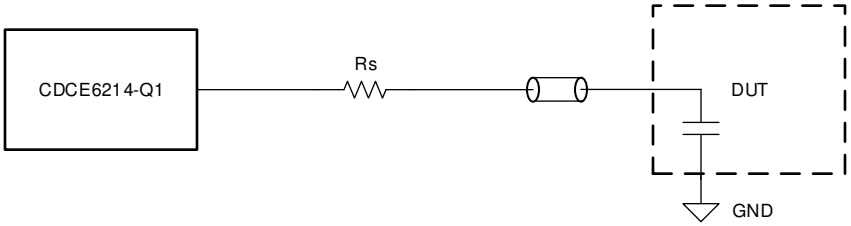
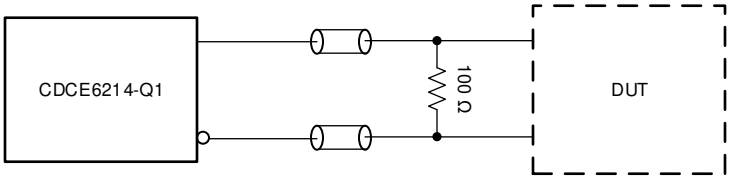


Figure 6-11. LVCMOS Output



A. Place 100Ω Resistor Close to the DUT

Figure 6-12. LVDS Output - DC-Coupled

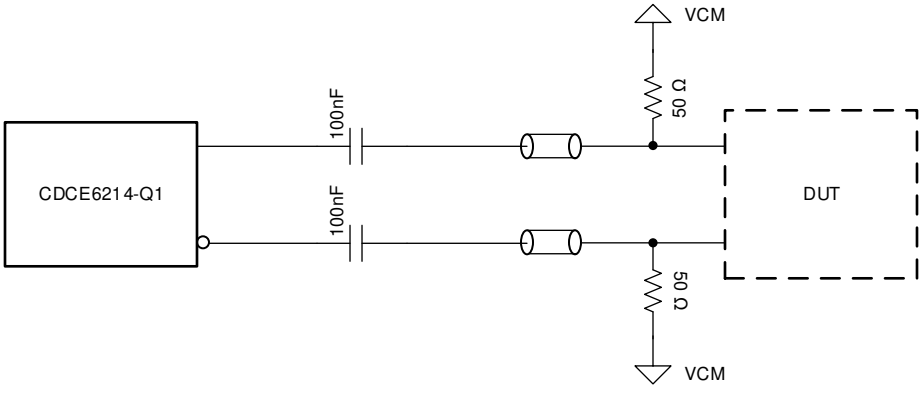


Figure 6-13. LVDS Output - AC-Coupled

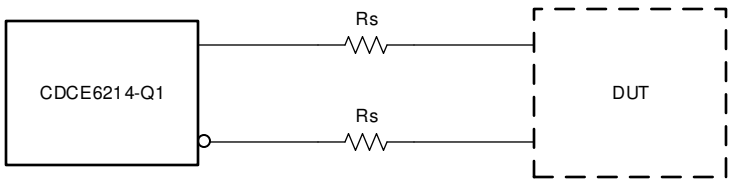


Figure 6-14. LP-HCSL Output

7 Detailed Description

7.1 Overview

The CDCE6214-Q1 automotive clock generator is a Phase-Locked Loop (PLL) with integrated voltage-controlled oscillator (VCO) and integrated loop filter with selectable input reference. The input reference supports XTAL, differential and single-ended LVCMOS inputs. The PLL has a Frac-N PLL with integrated VCO range of 2335MHz to 2625MHz. The output of the VCO is connected to the clock distribution network, which includes multiple frequency dividers and multiplexers. The output of these network is connected to four output channels with configurable differential and single-ended buffers. There are four power supply pins which can be independently configured to a 1.8V, 2.5V, or 3.3V power supply. By default, the CDCE6214-Q1 can be configured using the I^2C serial interface in fall-back mode only at power up, with I^2C mode disabled in both EEPROM pages. This device supports various modes such as a digitally-controlled oscillator (DCO) through the GPIO, I2C, internal or external Zero Delay mode.

7.2 Functional Block Diagram

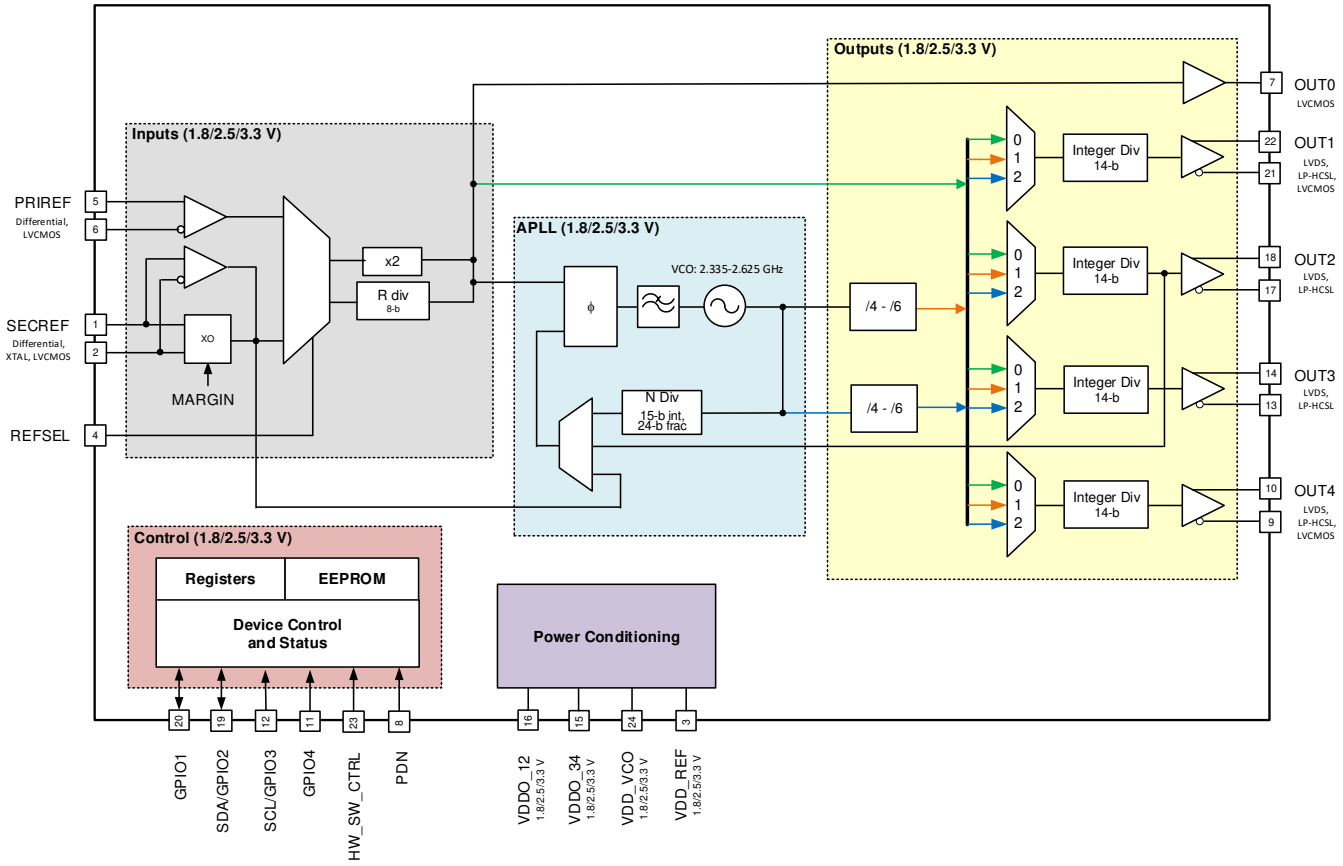


Figure 7-1. CDCE6214-Q1 Clock Generator With Two Inputs, One Fractional-N PLL, and Four Outputs

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7.3 Feature Description

The following sections describe the individual blocks of the CDCE6214-Q1 ultra-low-power clock generator.

7.3.1 Reference Block

A reference clock to the PLL is fed to pins 1 (SECREF_P) and 2 (SECREF_N) or to pins 5 (PRIREF_P) and 6 (PRIREF_N). There are multiple input stages to accommodate various clock references. Pins 1 and 2 can be used to connect a XTAL across the clock, or provide an external single-ended LVCMOS clock or differential clock. These modes are selectable through register programming. When differential mode is selected, appropriated biasing is applied to the pin. In case of differential mode, an external AC-coupling capacitor is required. When XTAL or LVCMOS mode is selected, biasing circuitry is disengaged. Pins 5 and 6 can be used to provide an external single-ended LVCMOS clock or a differential clock.

The reference MUX selects the reference clock for the PLL. Setting REFSEL pin = L selects SECREF input, while setting REFSEL pin = H selects PRIREF Input. Alternatively, this can be configured through the register settings.

Table 7-1. Reference Input Selection

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	VALUE	DESCRIPTION
R2[1:0]	REFSEL_SW	0h or 1h	Input Reference Mux controlled through Pin 4 (REFSEL)
	(Default: 0h)	2h	Pin1/Pin 2 SECREF Input selected. This is independent of Pin 4 status.
		3h	Pin 5/Pin 6 PRIREF Input selected. This is independent of Pin 4 status.
R24[1:0]	IP_SECREF_BUF_SEL	0h	XO enabled. Valid for SECREF pins.
	(Default: 0h)	1h	LVCMOS Buffer enabled. Valid for SECREF pins.
		2h or 3h	Differential Buffer enabled. Valid for SECREF pins.
R24[15]	IP_PRIREF_BUF_SEL	0h	LVCMOS Buffer enabled. Valid for PRIREF pins.
	(Default: 0h)	1h	Differential Buffer enabled. Valid for PRIREF pins.

A reference divider or a clock-doubler can be engaged to further multiply (2x) or divide the reference clock to the PLL. IP_RDIV[7:0] can be used to set the value of the divider. Setting IP_RDIV[7:0] to 00h enables the doubler.

The output clock from the reference block can be bypassed to the OUT0 and other output channels. The bypassed clock is selectable between the Input clock or PFD clock. See Table 7-9.

The SECREF_P and SECREF_N pins provide a crystal oscillator stage to drive a fundamental mode crystal in the range of 10MHz to 50MHz. The crystal input stage integrates a tunable load capacitor array up to 9pF and programmable through R24[12:8]. The drive capability of the oscillator is programmable through R24[5:2].

The LVCMOS input buffer threshold voltage follows VDD_REF. This device can be used as a level shifter because the outputs have separate supplies.

7.3.1.1 Zero Delay Mode, Internal and External Path

The CDCE6214-Q1 can operate in Zero Delay Mode with internal as well as external feedback. In Zero Delay Mode, PRIREF clock is used as the reference clock to the PFD. SECREF input clock can be used to feed an external source as feedback clock to the PFD. External feedback path is recommended for Zero Delay operation. Moreover there is an additional internal feedback path which is sourced from output channel 2. The

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Input-output propagation delay is expected to be higher in internal Zero Delay Mode than in external Zero Delay Mode.

Table 7-2. Zero Delay Operation

OPERATION[1] [2]	REFSEL	R2[1:0] - REFSEL_SW	R24[1:0] - IP_SECREF_BUF_SEL[3]	R24[15] - IP_PRIREF_BUF_SEL[3]	R0[8] - ZDM_EN	R0[10] - ZDM_CLOCKSEL	DESCRIPTION
Normal Operation, XTAL Input	L	0h or 1h or 2h	0h	X	0h	0h	Normal Operation, XTAL Input
Normal Operation, Differential Input	L	0h or 1h or 2h	2h or 3h	X	0h	0h	SECREF/ Differential Input
Normal Operation, Differential Input	H	0h or 1h or 3h	X	1h	0h	0h	PRIREF/ Differential Input
Normal Operation, LVCMOS Input	L	0h or 1h or 2h	1h	X	0h	0h	SECREF/ LVCMOS Input
Normal Operation, LVCMOS Input	H	0h or 1h or 3h	X	0h	0h	0h	PRIREF/ LVCMOS Input
External Zero Delay Mode, Differential Input	H	0h or 1h or 3h	2h or 3h	1h	1h	1h	Input Clock on PRIREF, Feedback clock on SECREF
External Zero Delay Mode, LVCMOS Input	H	0h or 1h or 3h	1h	0h	1h	1h	Input Clock on PRIREF, Feedback clock on SECREF
Internal Zero Delay Mode, Differential Input	H	0h or 1h or 3h	X	1h	1h	0h	Input clock on PRIREF
Internal Zero Delay Mode, Differential Input	H	0h or 1h or 3h	X	0h	1h	0h	Input clock in PRIREF

(1) In Zero Delay Mode, all dividers must be programmed such that PLL can lock. On power-up in Zero Delay Mode, PLL locks automatically
(2) For internal Zero Delay Mode, channel 2 is required. Channel 2 must not be powered down
(3) "X" allows any possible bit field value without any impact on the functionality

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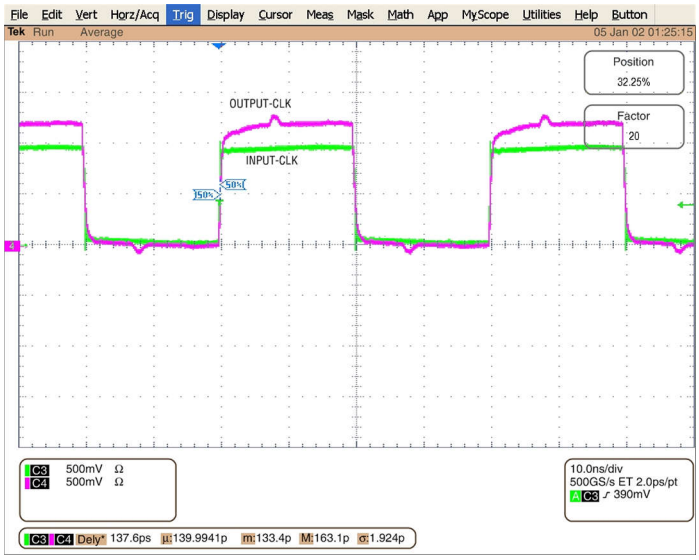


Figure 7-2. Input/Output Alignment in External Zero Delay Mode for LVCMOS Output

7.3.2 Phase-Locked Loop (PLL)

The CDCE6214-Q1 has a fully-integrated Phase-Locked Loop (PLL) circuit. The error between a reference phase and an internal feedback phase is compared at the phase-frequency detector. The comparison result is fed to a charge pump that is connected to an integrated loop filter. The control voltage resulting from the loop filter tunes an internal voltage-controlled oscillator (VCO). The frequency of the VCO is fed through a feedback divider (N-counter) back to the PFD.

- Integer and Fractional-N PLL mode of operation.
- First-, Second-, or Third-Order MASH operation in Fractional mode.
- 24-bit Numerator and Denominator can be used to generate fractional frequencies with 0ppb frequency accuracy.
- PFD operates between 1MHz and 100MHz.
- Live Lock Detector (R7[0] or PLL_LOCK in GPIO) provides PLL Lock status (if the PLL is operating in fractional mode, SSC is enabled, or dual PFD is enabled, the lock detect window must be widened to the maximum setting. PLL_LOCKDET_WINDOW (R50[10:8]) = 7h). Additionally, sticky bit lock detect (R7[1]) detects if there is any temporary loss of lock.
- Integrated selectable loop filter components.
- For a 25MHz PFD frequency, PFD bandwidth between 100kHz and 1.6MHz can be achieved to optimize PLL to input reference.
- Voltage-controlled oscillator (VCO) ranges from 2335MHz to 2615MHz.
- Supports 0.25% and 0.5% center and down spread Spread Spectrum Clocking (SSC) generation. Further, VCO also supports up to 0.5% SSC references at 100MHz for PCIe clocking.

Table 7-3. Common Clock Generator Loop Filter Settings

f_{VCO} IN MHz	f_{PFD} IN MHz	BW IN MHz	PHASE MARGIN IN °	DAMPING FACTOR	I_{CP} IN mA	C_{Pcap} IN pF	R_{Res} IN kΩ	C_{Zcap} IN pF
2400	25	0.469	70	0.5	0.60	16.1	2.5	580
2400	50	0.938	70	2	0.60	8.2	2.5	276
2400	100	1.60	70	0.5	0.80	8.2	2.5	303
2457.6	61.44	1.04	70	1.15	0.60	9.2	2.0	331
2500	25	0.49	70	0.4	0.60	13.5	2.5	497
2500	50	0.93	70	1.0	0.60	11.7	2.5	386
2400	50	400	65	0.1	0.40	11.7	1.5	636

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Table 7-4. Common PLL Divider Settings [1]

INPUT FREQUENCY IN MHz	f_{PFD} IN MHz	OUTPUT FREQUENCY IN MHz	f_{VCO}	N-COUNTER DIVIDER VALUE	NUMERATOR	DENOMINATOR	PSA	OUTPUT DIVIDER
25	50	100	2400	48	NA	NA	4	6
25	25	100	2400	96	NA	NA	4	6
25	50	156.25	2500	50	NA	NA	4	4
25	25	25	2400	96	NA	NA	4	24
25	25	24.576	2457.6	98	5071614	16682942	4	25
25	25	148.5	2376	95	664983	16624579	4	4

7.3.2.1 PLL Configuration and Divider Settings

$$f_{PFD} = \frac{F_{in}}{F_{factor}} \quad (1)$$

F_{factor} is determined by R25[7:0] - ip_ref_div. F_{factor} = 0.5 when ip_ref_div = 0, F_{factor} = ip_ref_div, otherwise.

$$f_{VCO} = f_{PFD} \times \left[N + \frac{Num}{Den}\right] \quad (2)$$

N is set by R30[14:0] - PLL_NDIV. Num is the numerator of the fraction, set by {R32[7:0],R31[15:0]}. Den is the denominator of the fraction, set by R34[7:0],R33[15:0]. When {R34[7:0],R33[15:0]} = 0, Den=2^{24}.

The sigma delta modulator supports different order of MASH to shape the quantization noise. For integer mode, R27[1:0] is set as 0h. For fractional mode, R27[1:0] can be set to 1h, 2h or 3h for first, second and third order, respectively.

In fractional mode, the PLL must be configured for dual PFD configuration by setting R51[6]=0h. In integer mode, the PLL can be configured in either a single-ended PFD configuration or dual PFD configuration. Single-ended PFD is enabled by setting R51[6]=1h. Further, PLL_PFD_DLY_EN (R51[10]) must be set as 1h in dual PFD mode and 0h in single-ended PFD mode.

7.3.2.2 Spread Spectrum Clocking

The energy of the harmonics from the rectangular clock signal can be spread over a certain frequency range. This frequency deviation leads to lowered average amplitude of the harmonics. This can help to mitigate electromagnetic interference (EMI) challenges in a system when the receiver supports this mode of operation. The modulation shape is triangular.

The SSC clock is generated through the fractional-N PLL. When SSC is enabled, SSC clock is available on all clock sourced from the PLL. Reference clock or PFD clock is available on the OUT1–OUT4 pins.

Down spread and center spread are supported. The following modes are supported.

- PFD frequencies: Either 25MHz or 50MHz.
- Down spread: –0.25% and ±0.5%
- Center spread: ±0.25% and ±0.5%

Pre-configured settings are available to select any of these combinations.

Using these pre-configured settings, fmod of 31.5kHz is synthesized for 100MHz output clock.

[1] Fractional Mode settings are based on DCO mode step size of 0.1ppm

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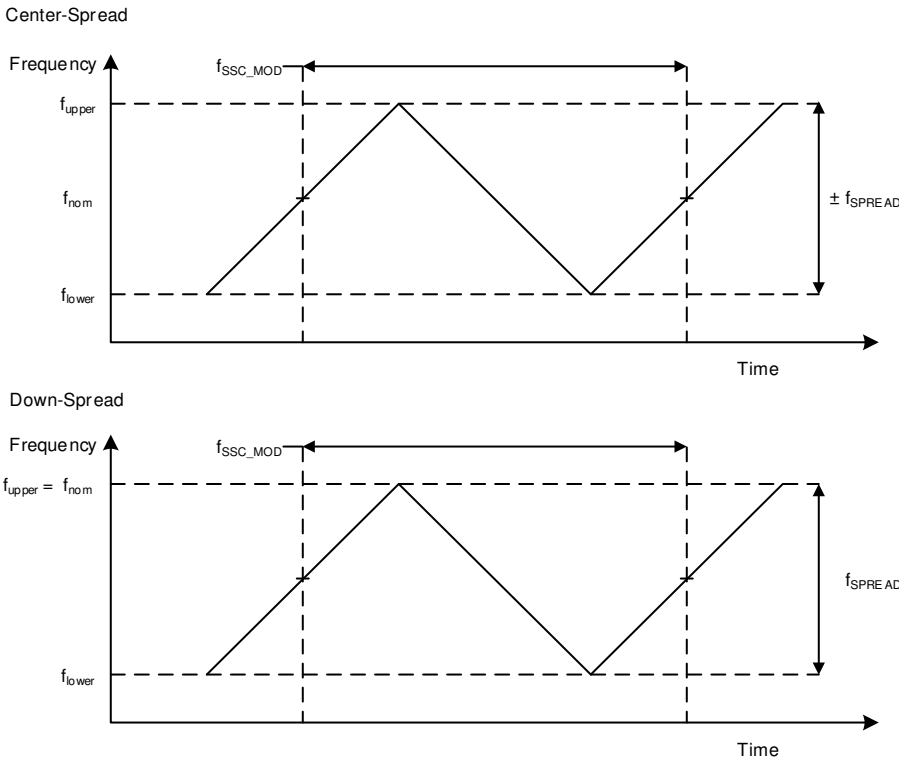


Figure 7-3. Spread Spectrum Clock

Table 7-5. Spread Spectrum Settings (2)

R41[15] - SSC_EN	R42[5] - SSC_TYPE(1)	R42[3:1] - SSC_SEL(1)	DESCRIPTION
0h	X	X	No SSC modulation at output
1h	0h	X	Down spread SSC modulation. SSC spread is determined by ssc_sel
1h	1h	X	Center spread SSC modulation. SSC spread is determined by ssc_sel
1h	X	0h	25MHz PFD, +/- 0.25% for Center spread, -0.25% for Down spread.
1h	X	1h	25MHz PFD, +/- 0.50% for Center spread, -0.50% for Down spread.
1h	X	2h	50MHz PFD, +/- 0.25% for Center spread, -0.25% for Down spread.
1h	X	3h	50MHz PFD, +/- 0.50% for Center spread, -0.50% for Down spread.
1h	X	4h-7h	Do not use

(1) "X" signifies that this bit field can take any value
(2) For any other SSC spread and modulation rate, please contact a TI representative.

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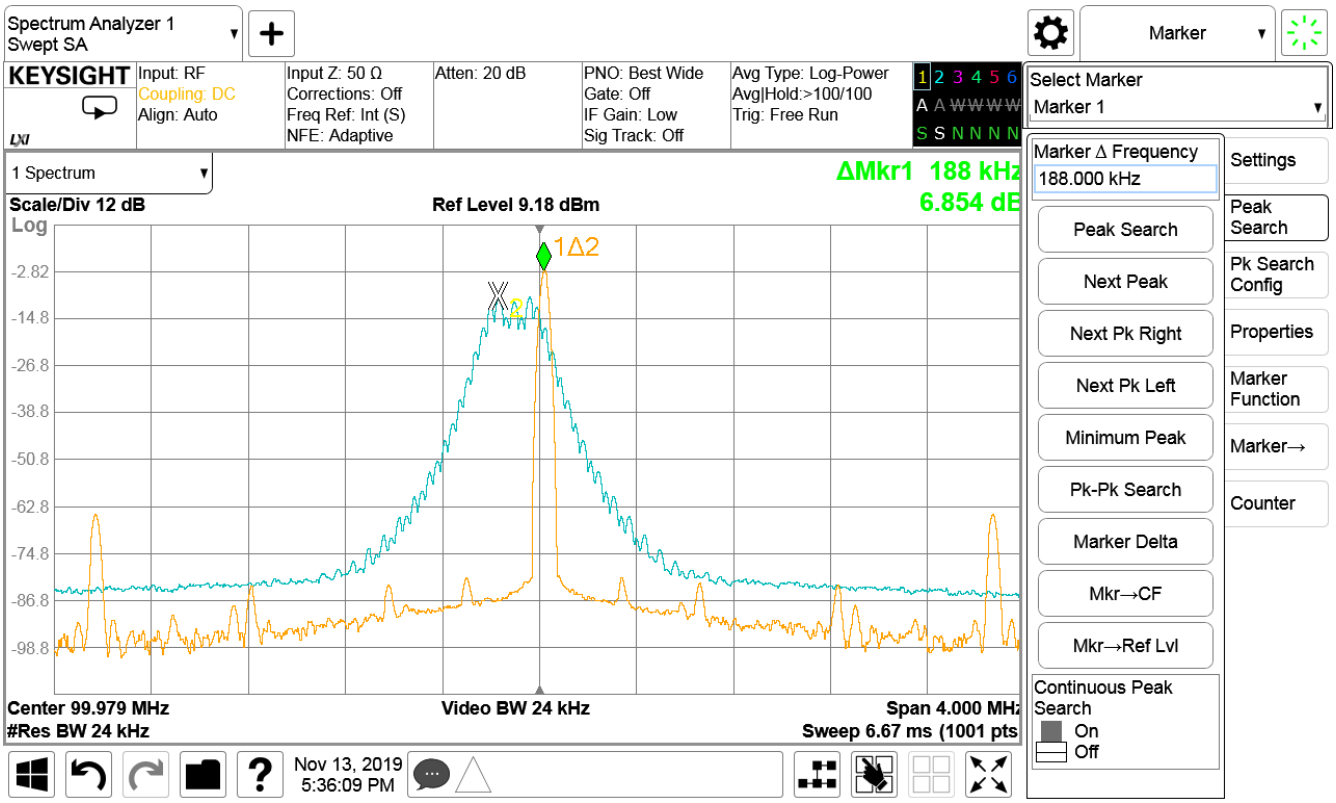


Figure 7-4. 100MHz With –0.25% Down Spread With and Without Trace

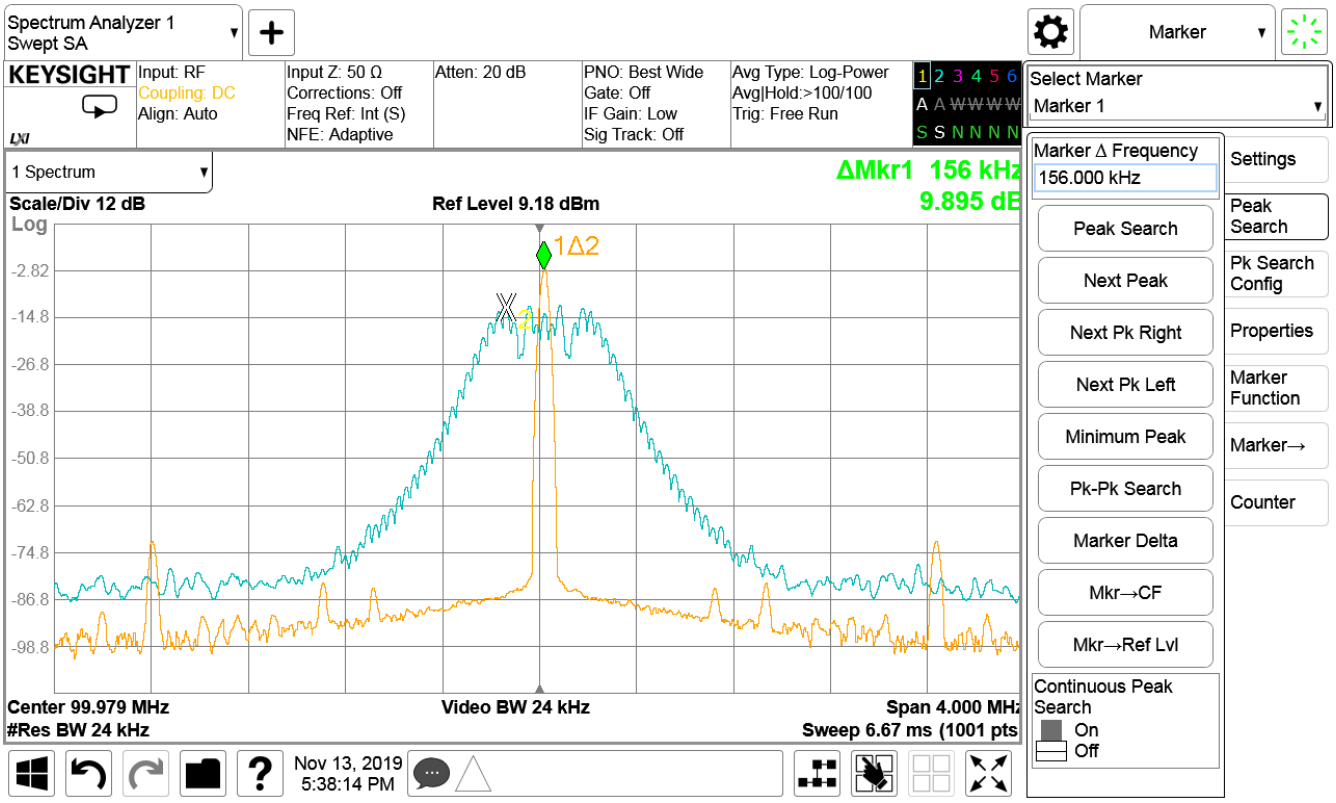


Figure 7-5. 100MHz With ±0.25% Center Spread With and Without Trace

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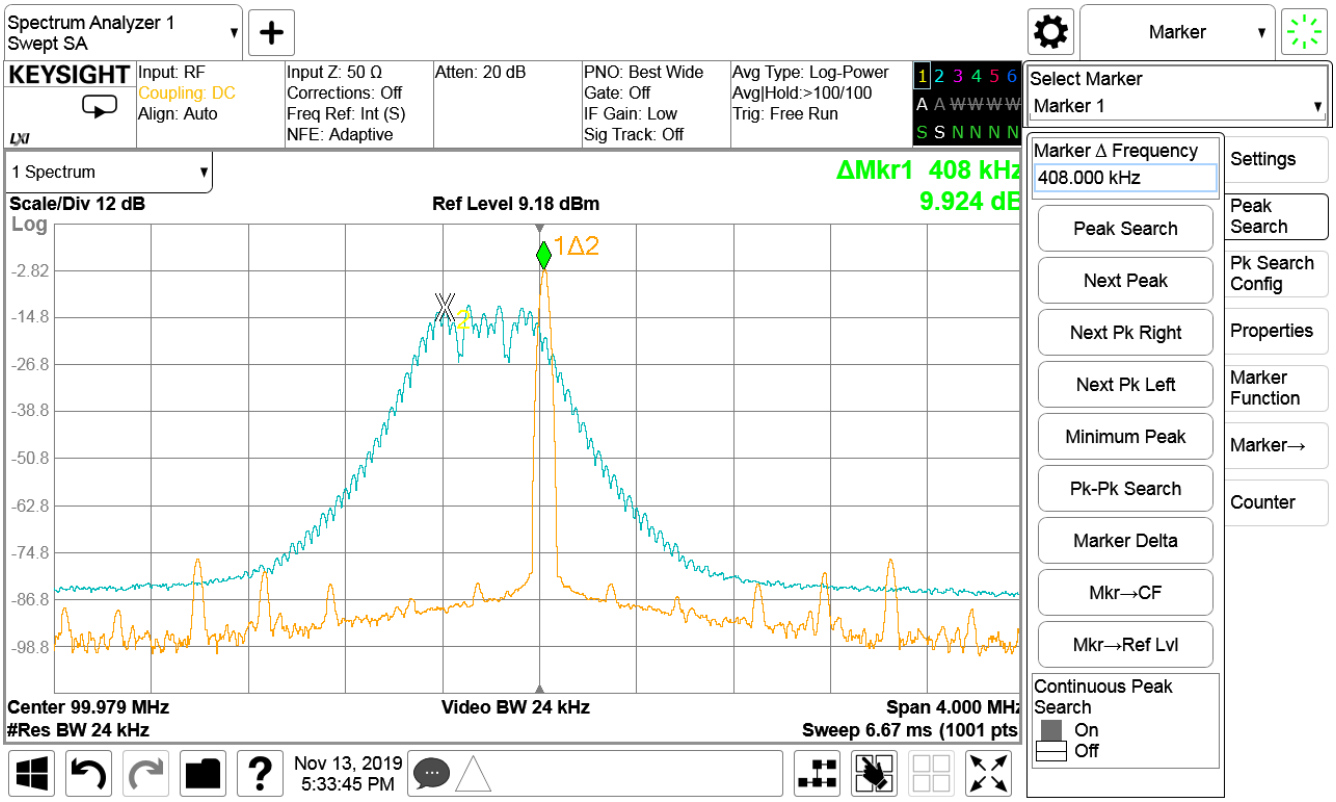


Figure 7-6. 100MHz With –0.5% Down Spread With and Without Trace

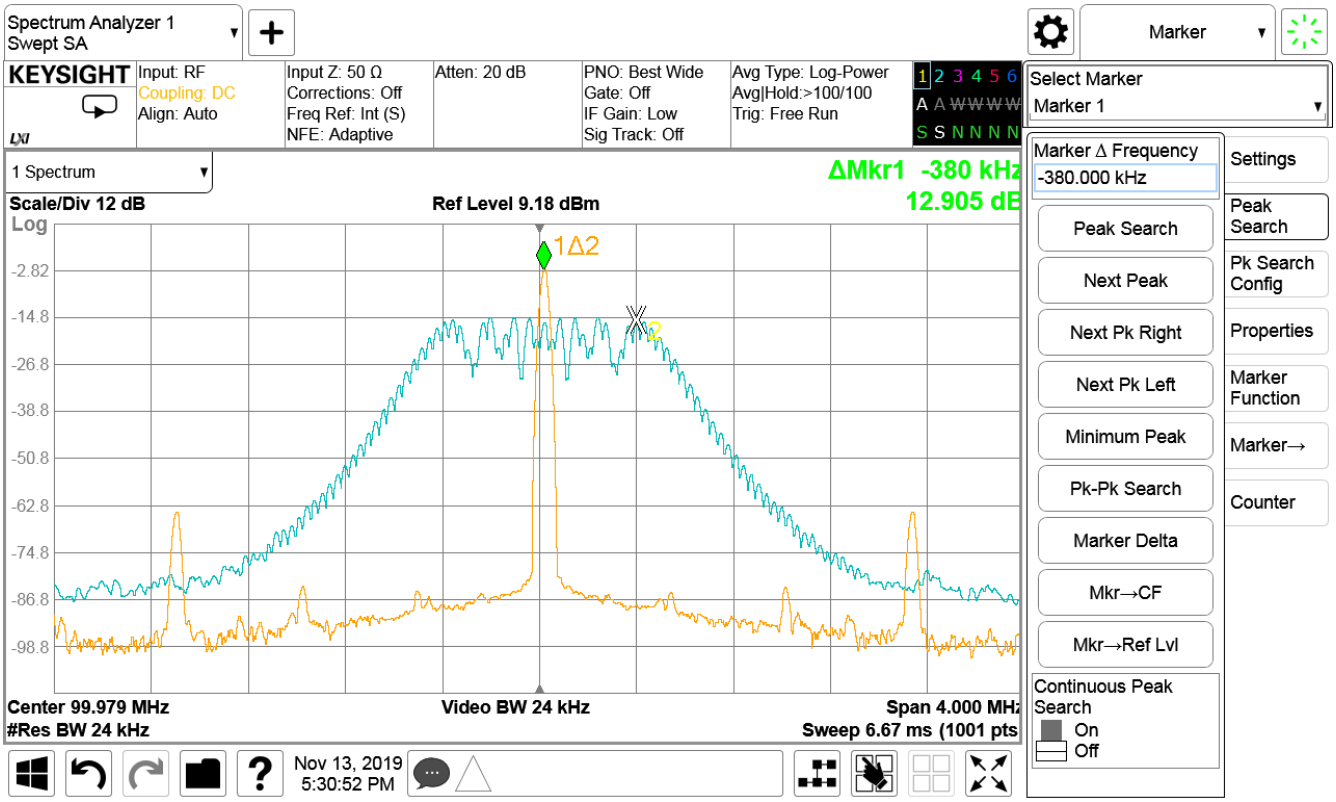


Figure 7-7. 100MHz With ±0.5% Center Spread With and Without Trace

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Table 7-6. PCI Express Compliance Measurement

NO.	CLASS	DATA RATE	ARCHITECTURE	MEASURED PNA METHOD	MEASURED SCOPE METHOD	SPEC LIMIT	RESULT
1	Gen4	16 Gb/s	CC	195 fs	260 fs	500 fs	PASS
2	Gen4	16 Gb/s	SRIS	-	490 fs	500 fs	PASS
3	Gen5	32 Gb/s	CC	87 fs	111 fs	150 fs	PASS
4	Gen5	32 Gb/s	SRIS	-	157 fs	*	*

7.3.2.3 Digitally-Controlled Oscillator and Frequency Increment or Decrement - Serial Interface Mode and GPIO Mode

In this mode, the output clock frequency can be incremented or decremented by a fixed frequency step. The frequency step size is determined by the register R43[15:0]. This value is added or subtracted to the numerator of the sigma-delta modulator. Every rising edge of FREQ_INC signal increases the output frequency, while every rising edge of FREQ_DEC signal decreases the output frequency. There are two ways to trigger the increment or decrement:

1. Appropriate configuration of the GPIOs and sending a FREQ_INC or FREQ_DEC signal through an external microcontroller or ASIC.
2. Using register bit fields controlled through serial interface.

Note that when DCO mode is enabled (FREQ_INC_DEC_EN (R3[3]) = 1h), the VCO automatically recalibrates if the PLL loses lock (for example, the LOCK_DET status transitions from 1h to 0h). To prevent the clock outputs from being temporarily muted during a VCO calibration, set CAL_MUTE (R15[5]) to 0h.

Table 7-7. Register Settings for Frequency Increment or Decrement Functionality

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R3[3]	FREQ_INC_DEC_EN	Enables/Disables DCO mode
R3[4]	FREQ_INC_DEC_REG_MODE	Selects DCO trigger through GPIOs or Serial Interface.
R3[6:5]	FREQ_DEC_REG, FREQ_INC_REG	Generates FREQ_INC or FREQ_DEC signal through serial Interface
R43[15:0]	FREQ_INC_DEC_DELTA	Frequency Increment or Decrement step size

Table 7-8. Computing Divider Settings in DCO Mode

PARAMETERS	VALUE (EXAMPLE)	DESCRIPTION
Input PFD Frequency (F_{PFD})	25MHz	Set according to F_{PFD}.
Expected VCO Frequency (F_{VCO})	2457.6MHz	F_{VCO} is set within the operating VCO range of 2335MHz to 2625MHz. F_{VCO} is selected such that PSA/PSB/Output Divider is Integer.
Expected Output Frequency (F_{OUT})	24.576MHz	PSA = 4, IOD = 25. F_{VCO} = PSA × IOD × F_{OUT}.
Expected step size (in ppm) (F_{step})	0.1	Every rising edge of FREQ_INC or FREQ_DEC changes the output by this step size.
N-divider Value (N)	98	INT(F_{VCO}/F_{PFD})
Minimum Numerator value to meet 0ppb accuracy (Num)	76	These values are computed to meet accuracy requirement at output. Must be less than 2^{24}.
Minimum Denominator to meet 0ppb accuracy (Den)	250	
Minimum Denominator value to meet ppm step size ($F_{DEN,min}$)	101725.26	1/(F_{step} × 1e6) / (F_{VCO}/F_{PFD})
Final Denominator value ($F_{DEN,final}$)	500000	$F_{DEN,final}$ must be greater than $F_{DEN,min}$ and less than 2^{24}. $F_{DEN,final}$ and $F_{NUM,final}$ must be an integer multiple of Den and Num respectively. $F_{DEN,final}$/Den = $F_{NUM,final}$/Num
Final Numerator value ($F_{NUM,final}$)	152000	

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Table 7-8. Computing Divider Settings in DCO Mode (continued)

PARAMETERS	VALUE (EXAMPLE)	DESCRIPTION
Increment or Decrement step size	5	This value must be less than 2^{16}-1. $F_{DEN,final}$ must be closest integer multiple of $F_{DEN,min}$.

7.3.3 Clock Distribution

The VCO output connects to two individually configurable pre-scalar dividers sourcing the on-chip clock distribution – PSA and PSB. PSA and PSB can be configured as division value of /4, /5 or /6 independently.

The clock distribution consists of four output channels. Each output channel contains an integer divider (IOD) with glitchless switching and synchronization capabilities.

IOD can be sourced from either the PSA, the PSB, or the Reference Clock. IOD can be bypassed to provide a Reference clock at the output.

There are five output channels – OUT0, OUT1, OUT2, OUT3, and OUT4.

The OUT0 is a slew-rate controllable LVCMOS output. Either the reference clock or PFD clock can be routed to this output through the clock distribution network.

The OUT1 and OUT4 are identical output channels. The output buffers in this channel are compatible with various signaling standards – LVCMOS, LP-HCSL, and LVDS-like.

The OUT2 and OUT3 are identical output channels. The output buffers in this channel are compatible with various signaling standards – LP-HCSL and LVDS-like.

- The LP-HCSL output buffer can be directly connected to the receiver without any termination resistor to GND. The output impedance of LP-HCSL is trimmed to 50Ω ± 10%. A series resistor can be used to adapt to the trace impedance.
- The LVDS-like requires a differential termination connected between the positive and negative polarity output pins. The termination can be connected directly or through an AC-coupling capacitor. For a 50Ω system, a 100Ω differential termination is appropriate.
- LVCMOS outputs are designed for capacitive loads only. The polarity of the positive and negative output pins can be configured individually.

The differential buffers support wide range of output frequencies up to 328.125MHz. LVCMOS supports up to 200MHz.

Table 7-9. Configuring Input Reference, PFD, or PLL Clock to Output(1)

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R25[10]	IP_BYP_OUT0_EN	Enables Reference Clock or PFD Clock to OUT0.
R25[9]	REF_CH_MUX	Selects between PFD Clock or Input Reference Clock
R25[14:11]	IP_REF_TO_OUT4_EN, IP_REF_TO_OUT3_EN, IP_REF_TO_OUT2_EN, IP_REF_TO_OUT1_EN	Selects reference clock to OUT1-OUT4
R56[15:14]	CH1_MUX	Clock selection MUX control for OUT1
R62[15:14]	CH2_MUX	Clock selection MUX control for OUT2
R67[15:14]	CH3_MUX	Clock selection MUX control for OUT3
R72[15:14]	CH4_MUX	Clock selection MUX control for OUT4

(1) TI recommends to disable any clock when not in use to reduce crosstalk

Table 7-10. Configuring Clock Distribution Network

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R47[6:5]	PLL_PSB	Programmable Pre-scalar divider PSB
R47[4:3]	PLL_PSA	Programmable Pre-scalar divider PSA

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Table 7-10. Configuring Clock Distribution Network (continued)

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R56[13:0]	CH1_DIV	OUT1 Integer Divider value
R62[13:0]	CH2_DIV	OUT2 Integer Divider value
R67[13:0]	CH3_DIV	OUT3 Integer Divider value
R72[13:0]	CH4_DIV	OUT4 Integer Divider value

Table 7-11. Configuring LVCMOS Output Buffer(1) (2)

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R78[12]	CH0_EN	Enables OUT0 LVCMOS Buffer
R79[3:0]	CH0_CMOS_SLEW_RATE_CTRL	Controls output slew rate of OUT0 LVCMOS Buffer
R59[14], R75[14]	CH1_CMOSN_EN, CH4_CMOSP_EN	Enables OUT1N/OUT4P LVCMOS Buffer
R59[13], R75[13]	CH1_CMOSP_EN, CH4_CMOSN_EN	Enables OUT1P/OUT4N LVCMOS Buffer
R59[12], R75[12]	CH1_CMOSN_POL, CH4_CMOSP_POL	Sets output polarity of OUT1N/OUT4P LVCMOS Buffer
R59[11], R75[11]	CH1_CMOSP_POL, CH4_CMOSN_POL	Sets output polarity of OUT1P/OUT4N LVCMOS Buffer
R60[3:0], R76[3:0]	CH1_CMOS_SLEW_RATE_CTRL, CH4_CMOS_SLEW_RATE_CTRL	Controls output slew rate of OUT1/OUT4 LVCMOS Buffer

(1) Multiple output buffers must not be enabled at the same time
(2) Based on the VDDO levels, ch1_1p8vdet, ch2_1p8vdet, ch3_1p8vdet, ch4_1p8vdet must be set accordingly. When setting for 1.8V, safety_1p8v_mode must be set.

Table 7-12. Configuring LP-HCSL Output Buffer(1) (2) (3)

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R57[14] , R63[13], R68[13], R73[13]	CH1_HCSL_EN, CH2_HCSL_EN, CH3_HCSL_EN, CH4_HCSL_EN	Enables LP-HCSL buffer on OUT1/OUT2/ OUT3/OUT4

(1) Multiple output buffers must not be enabled at the same time
(2) External termination not needed. Voltage mode driver.
(3) Based on the VDDO levels, ch1_1p8vdet, ch2_1p8vdet, ch3_1p8vdet, ch4_1p8vdet must be set accordingly. When setting for 1.8V, safety_1p8v_mode must be set.

Table 7-13. Configuring LVDS-Like Output Buffer(1) (2) (3)

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R59[15], R65[11], R70[11], R75[15]	CH1_LVDS_EN, CH2_LVDS_EN, CH3_LVDS_EN, CH4_LVDS_EN	Enables LVDS-like buffer on OUT1/OUT2/ OUT3/OUT4
R60[15:12], R66[3:0], R71[3:0], R76[9:6]	CH1_DIFFBUF_IBIAS_TRIM, CH2_DIFFBUF_IBIAS_TRIM, CH3_DIFFBUF_IBIAS_TRIM, CH4_DIFFBUF_IBIAS_TRIM	Sets the output swing and output common mode of OUT1/OUT2/OUT3/OUT4
R60[11:10], R66[5:4], R71[5:4], R76[5:4]	CH1_LVDS_CMTRIM_INC, CH2_LVDS_CMTRIM_INC, CH3_LVDS_CMTRIM_INC, CH4_LVDS_CMTRIM_INC	Increases the output common mode of OUT1/OUT2/OUT3/OUT4. 2.5V/3.3V mode only.
R60[5:4], R65[14:13], R71[10:9], R77[1:0]	CH1_LVDS_CMTRIM_DEC, CH2_LVDS_CMTRIM_DEC, CH3_LVDS_CMTRIM_DEC, CH4_LVDS_CMTRIM_DEC	Decreases the output common mode of OUT1/OUT2/OUT3/OUT4. For 2.5V or 3.3V mode only.

(1) Multiple output buffers must not be enabled at the same time.
(2) 100Ω differential termination needed in DC-coupled mode. A 50Ω, single-ended or 100Ω differential termination is needed in AC-coupled mode
(3) Based on the VDDO levels, ch1_1p8vdet, ch2_1p8vdet, ch3_1p8vdet, ch4_1p8vdet must be set accordingly. When setting for 1.8V, safety_1p8v_mode must be set.

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7.3.3.1 Glitchless Operation

The bit fields ch{x}_glitchless_en can be used to enable glitchless output divider update. This feature verifies that the high pulse of a clock period is not cut off by the output divider update process. This feature also verifies that setup and hold time of a receiver is not violated. The low pulse in the transition from earlier period to the new period is extended accordingly.

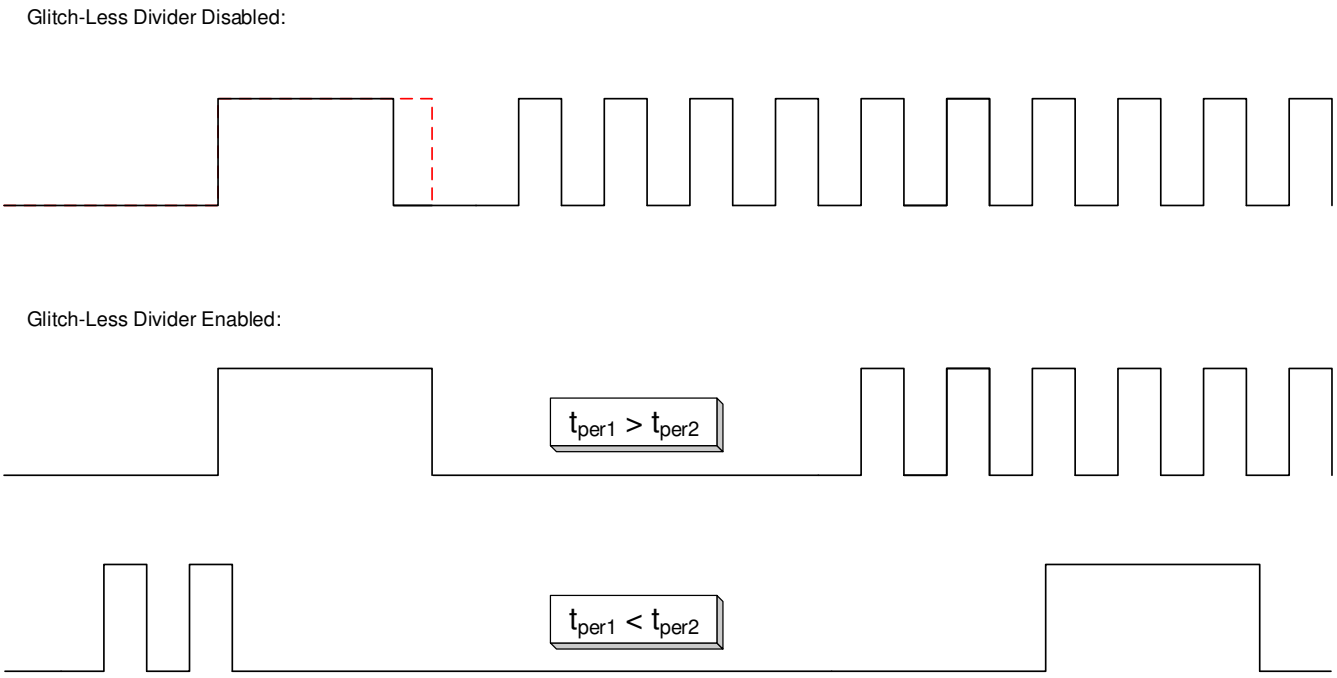


Figure 7-8. Glitchless Divider Update

7.3.3.2 Divider Synchronization

The output dividers can be reset in a deterministic way. This can be achieved using the sync bit or PDN pin. The level of the pin is qualified internally using the reference frequency at the PFD input. A low level on the SYNCN pin or sync bit mutes the outputs. A high level synchronously releases all output dividers to operation so that all outputs share a common rising edge. The first rising edge can be individually delayed in steps of the respective pre-scalar period, up to 32 cycles using ch{x}_sync_delay. This allows the user to compensate external delays like routing mismatch, cables, or inherent delays introduced by logic gates in an FPGA design. Each channel can be included or excluded from the SYNC process. Divider synchronization can be enabled individually by ch{x}_sync_en.

For a deterministic behavior over power-cycles seen from input to output, the reference divider must be set to 1. The reference divider must not divide the reference clock or use the reference doubler.

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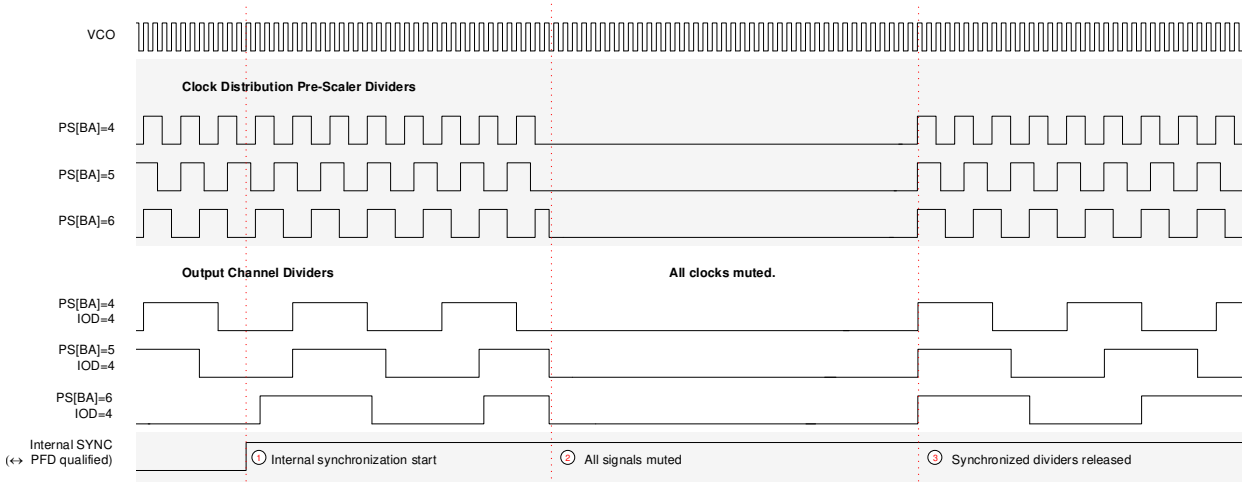


Figure 7-9. Output Divider Synchronization

7.3.3.3 Global and Individual Output Enable

The output enable functionality allows the user to enable or disable all or a specific output buffer. The bypass copy on OUT0 is excluded from the global output enable signal. When an output is disabled, the signal drives a configurable mute-state. When the serial interface is deactivated, one can use all individual output enable signals at the same time. The individual output enable signal controls the respective output channel integer divider to gate the clock, therefore each integer divider must be active.

The individual output enable signal enables and disables the respective output in a deterministic way. Therefore the high and low level of the signal is qualified by counting four cycles of the respective output clock.

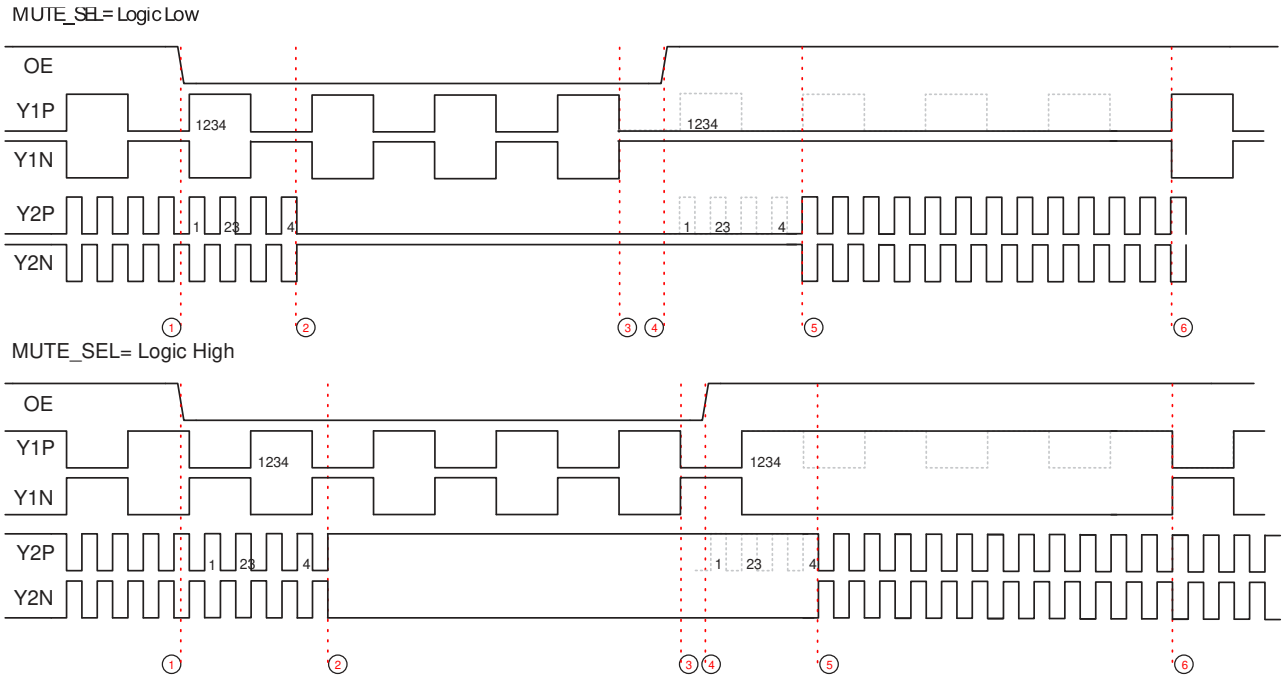


Figure 7-10. Individual Output Enable and Disable

Table 7-14. Glitchless Operation and Divider Synchronization

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R0[14]	PDN_INPUT_SEL	Configures PDN pin as PDN or SYNCN

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Table 7-14. Glitchless Operation and Divider Synchronization (continued)

REGISTER BIT ADDRESS	REGISTER BIT FIELD NAME	DESCRIPTION
R0[5]	SYNC	Generates SYNC signal through serial interface
R57[9], R63[9], R68[9], R73[9]	CH1_GLITCHLESS_EN, CH2_GLITCHLESS_EN, CH3_GLITCHLESS_EN, CH4_GLITCHLESS_EN	Enables Glitchless switching for OUT1/OUT2/OUT3/OUT4
R57[3], R63[3], R68[3], R73[3]	CH1_SYNC_EN, CH2_SYNC_EN, CH3_SYNC_EN, CH4_SYNC_EN	Enables SYNC for OUT1/OUT2/OUT3/OUT4
R57[1], R63[1], R68[1], R73[1]	CH1_MUTESEL, CH2_MUTESEL, CH3_MUTESEL, CH4_MUTESEL	Sets Output level when mute on OUT1/OUT2/OUT3/OUT4
R57[0], R63[0], R68[0], R73[0]	CH1_MUTE, CH2_MUTE, CH3_MUTE, CH4_MUTE	Mutes output on OUT1/OUT2/OUT3/OUT4

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7.3.4 Power Supplies and Power Management

The CDCE6214-Q1 provides multiple power supply pins. Each of the power supplies supports 1.8V, 2.5V, or 3.3V individually. Internal low-dropout regulators (LDO) source the internal blocks and allow each pin to be supplied with an individual supply voltage. The VDDREF pin supplies the control pins and the serial interface, therefore any pullup resistors are connected to the same domain as VDDREF.

The device is very flexible with respect to internal power management. Each block offers a power-down bit and can be disabled to save power when the block is not required. Table 7-15 shows the available bits. The bypass output Y0 is connected to the pdn_ch4 bit. Each output channel has a bit which must be adapted to the applied supply voltage, ch[4:1]_1p8vdet.

Table 7-15. Power Management

VDDREF	VDDVCO	VDDO_12	VDDO_34
R0[1] - POWERDOWN	R0[1] - POWERDOWN	R0[1] - POWERDOWN	R0[1] - POWERDOWN
	R5[8] - PLL_VCOBUFF_LDO_PD	R4[4] - CH1_PD	R4[6] - CH3_PD
	R5[7] - PLL_VCO_LDO_PD	R4[5] - CH2_PD	R4[7] - CH4_PD
	R5[6] - PLL_VCO_BUFF_PD		
	R5[5] - PLL_CP_LDO_PD		
	R5[4] - PLL_LOCKDET_PD		
	R5[3] - PLL_PSB_PD		
	R5[2] - PLL_PSA_PD		
	R5[1] - PLL_PFD_PD		
	R53[6] - PLL_NCTR_EN		
	R53[3] - PLL_CP_EN		

7.3.5 Control Pins

The ultra-low power clock generator is controlled by multiple LVCMOS input pins.

The HW_SW_CTRL pin acts as an EEPROM page select. The CDCE6214-Q1 clock generator contains two pages of configuration settings. The level of this pin is sampled after device power up. A low level selects page zero. A high level selects page one. The HW_SW_CTRL pin is a tri-level input pin. This third voltage level is automatically applied by an internal voltage divider. The mid-level is used to select an internal default where the serial interface is enabled.

The PDN/SYNCN (pin 8), SCL (pin 12), and SDA (pin 19) have a secondary functionality and can act as general-purpose inputs and outputs (GPIO). This means that either the serial interface or the GPIO functionality can be active.

The PDN/SYNCN resets the internal circuitry and is used in the initial power-up sequence. The pin can be reconfigured to act as synchronization input. The differential outputs are kept in mute while SYNCN is low. When SYNCN is high, outputs are active.

When the SSC_EN bit is set to 1, then SSC is enabled regardless of the pin state.

When the SSC_EN bit is set to 0, then the SSC functionality can be controlled by the GPIO pins. This is limited to starting up with SSC enabled (GPIOx = HIGH), then disabling by pulling the GPIOx pin low.

Table 7-16. Control and GPIO Pins

PIN NO.	NAME	TYPE	2-LEVEL INPUT	3-LEVEL INPUT	OUTPUT	TERMINATION
23	HW_SW_CTRL	Input	-	Yes	-	PUPD
20	GPIO1	Input/Output	Yes	-	Yes	-
19	GPIO2	Input/Output	Yes	-	Yes	Open-Drain I/O in I^2C mode, CMOS (Input)
12	GPIO3	Input	Yes	-	-	-

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Table 7-16. Control and GPIO Pins (continued)

PIN NO.	NAME	TYPE	2-LEVEL INPUT	3-LEVEL INPUT	OUTPUT	TERMINATION
11	GPIO4	Input/Output	Yes	-	Yes	-
8	PDN	Input	Yes	-	-	PU (when Input)
4	REFSEL	Input	-	Yes	-	PUPD

Table 7-17. GPIO Input and Output Signal List

ABBREVIATION	TYPE	DESCRIPTION
FREQ_INC	Input	Frequency Increment; Increments the MASH numerator
FREQ_DEC	Input	Frequency Decrement; Decrements the MASH numerator
OE (global)	Input	Enables or disables all differential outputs Y[4:1] (bypass not affected)
SSC_EN	Input	Enables or disables SSC.
OE1	Input	Enables or disables OUT1
OE2	Input	Enables or disables OUT2
OE3	Input	Enables or disables OUT3
OE4	Input	Enables or disables OUT4
PLL_LOCK	Output	PLL Lock Status. 0 = PLL out of lock; 1 = indicates PLL in lock

7.4 Device Functional Modes

7.4.1 Operation Modes

The operating modes listed in Table 7-18 can be set, and the GPIOs configured. An operating mode change only becomes effective when the change is loaded from the EEPROM after a power cycle.

Table 7-18. Modes of Operations

DESCRIPTION	MODE	REFSEL	HW_SW_CTRL	GPIO1	GPIO2	GPIO3	GPIO4
I^2C + GPIO	Fall-back	M	M	I/O	SDA	SCL	I/O
		M	L/H	I/O	SDA	SCL	I/O
		L/H	M	I/O	SDA	SCL	I/O
OE	Pin Mode	L/H	L/H	OE1	OE2	OE3	OE4
I^2C + GPIO	Serial Interface Mode	L/H	L/H	I/O	SDA	SCL	I/O

7.4.1.1 Fall-Back Mode

As the programming interface can be intentionally deactivated using the EEPROM, an accidental disabling of the I^2C blocks further access to the device. The serial interface can be forced using the fall-back mode. To enter this mode, the user leaves pin 4 or pin 23 floating while the supply voltage is applied to VDDREF. In this mode, EEPROM Read at power up is bypassed and device boots in default mode. In this mode, pin 11 is pre-configured as an input and pin 20 is configured as an output. After powering up in fall-back mode, the device can be re-programmed through serial interface and be re-configured for normal operation. EEPROM can also be re-programmed. The PLL is not auto-calibrated, however, and the I^2C interface is active. This mode allows the user to fully configure the device before re-locking the PLL.

7.4.1.2 Pin Mode

In pin mode, the pins 12 and 19 are input pins which act as individual output enable pins. Together with pins 11 and 20, this allows for one output enable pin per output channel.

7.4.1.3 Serial Interface Mode

In serial interface mode, pins 12 and 19 are configured as an I^2C interface.

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7.5 Programming

7.5.1 I²C Serial Interface

The CDCE6214-Q1 ultra-low power clock generator provides an I²C-compatible serial interface for register and EEPROM access. The device is compatible to standard-mode I²C at 100kHz and the fast-mode I²C at 400kHz clock frequency.

1. In fall-back mode with REFSEL floating, I²C target address = 67h.
2. In other modes, I²C target address = 68h when the interface is available. By default, the interface is not available.
3. The LSB bit of the device can be programmed in the EEPROM. For example, if I2C_A0 is programmed H in Page 0 of EEPROM, setting HW_SW_CTRL=0 sets the I²C address as 69h.
4. Two devices with EEPROM + 1 device in fall-back mode can be used on the same I²C bus with addresses 67h, 68h and 69h.

Table 7-19. I²C-Compatible Serial Interface, Target Address Byte(1)(2)

7	6	5	4	3	2	1	0
Target Address [6:0]							R/W# Bit

(1) The target address consists of two sections. The hardwired MSBs A[6:1] and the software-selectable LSBs A[0].
(2) The R/W# bit indicates a read (1) or a write (0) transfer.

Table 7-20. I²C-Compatible Serial Interface, Programmable Target Address(1)(2)

A6	A5	A4	A3	A2	A1	A0	HW_SW_SEL	REFSEL	DESCRIPTION
1	1	0	0	1	1	1	L/M/H	M	Fall-back Mode
1	1	0	1	0	0	0	M	L/H	Fall-back Mode
1	1	0	1	0	0	I2C_A0	L	L/H	EEPROM Page 0
1	1	0	1	0	0	I2C_A0	H	L/H	EEPROM Page 1

(1) In EEPROM Page 0, Serial Interface is not available. Device is configured in Pin Mode.
(2) In EEPROM Page 1, Serial Interface is not available. Device is configured in Pin Mode.

The serial interface uses the following protocol as shown in Figure 7-11. The target address is followed by a word-wide register offset and a word-wide register value.

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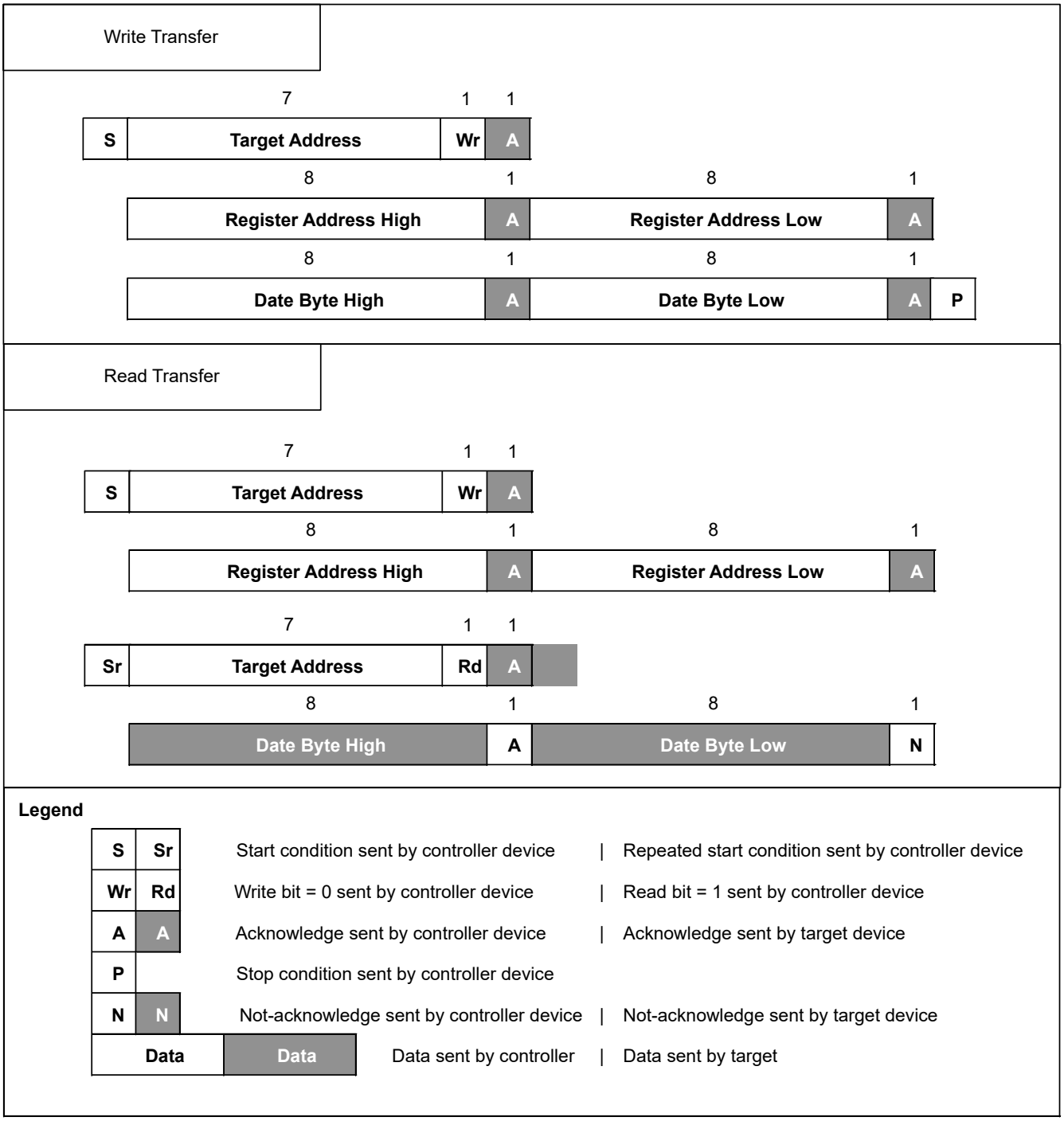


Figure 7-11. I²C-Compatible Serial Interface, Supported Protocol

7.5.2 EEPROM

7.5.2.1 EEPROM - Cyclic Redundancy Check

The device contains a cyclic redundancy check (CRC) function for reads from the EEPROM to the device registers. At start-up, the EEPROM is read internally and a CRC value calculated. One of the EEPROM words contains an earlier stored CRC value. The stored and the actual CRC value are compared and the result transferred to register. The CRC calculation can be triggered again by writing a 1 to the update_crc bit. A mismatch between stored and calculated CRC value is informational only and non-blocking to the device operation. Just reading back the CRC status bit and the live CRC value can speed up in-system EEPROM programming and avoid reading back each word of the EEPROM for known configurations.

The polynomial used is CCITT-CRC16: $x^{16} + x^{12} + x^5 + 1$.

7.5.2.2 Recommended Programming Procedure

TI recommends programming the registers of the device in the following way:

1. Read-back factory default EEPROM page configuration. Each device has different EEPROM base page configurations.
2. Modify register bits.
3. Verify that the ee_lock is set to 5h (unlock) when overwriting the EEPROM.
4. Program register addresses in descending order from 0x53 to 0x00 including all register addresses with reserved values.

7.5.2.3 EEPROM Access

Note

The EEPROM word write access time is typically 8ms.

There are two methods to write into the internal EEPROM

1. Register Commit method.
2. EEPROM Direct Access Method

Use the following steps to bring the device into a good known configuration.

1. Power down all the supplies.
2. Apply PDN = LOW.
3. REFSEL and HW_SW_CTRL pins can be High, Low or High-Z. For factory programmed device, I^2C interface is not available for any HW_SW_CTRL pin state. EEPROM can only be programmed in fall-back mode.
4. Apply power supplies to all VDD pins. When device operation is not required, apply power supply to VDDREF.
5. Apply PDN = HIGH.
6. Use the I^2C interface to configure the device.

7.5.2.3.1 Register Commit Flow

In the Register Commit flow, all bits from the device registers are copied into the EEPROM. The recommended flow is:

1. Pre-configure the device as desired, except the serial interface using mode.
2. Write 1 to RECAL to calibrate the VCO in this operation mode.
3. Select the EEPROM page, to copy the register settings into, using REGCOMMIT_PAGE.
4. Unlock the EEPROM for write access with EE_LOCK = x5.
5. Start the register commit operation by writing 1 to REGCOMMIT.
6. Force a CRC update by writing a 1 to UPDATE_CRC.
7. Read back the calculated CRC in NVMLCRC.

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8. Store the read CRC value in the EEPROM by writing 0x3F to NVM_WR_ADDR and then the CRC value to NVM_WR_DATA.

7.5.2.3.2 Direct Access Flow

In the EEPROM direct access flow, the EEPROM words are directly accessed using the address and the data bit-fields. The recommended flow is:

1. Prepare an EEPROM image consisting of 64 words of 16 bits each.
2. Unlock the EEPROM for write access with EE_LOCK = 0x5.
3. Write the initial address offset to the address bit-field. Write a 0x00 to NVM_WR_ADDR.
4. Loop through the EEPROM image from address 0 to 63 by writing each word from the image to NVM_WR_DATA. The EEPROM word address is automatically incremented by every write access to NVM_WR_DATA.



Figure 7-12. EEPROM Direct Access Using I²C

7.5.2.4 Register Bits to EEPROM Mapping

Register bits settings are mapped into EEPROM. EEPROM is divided into three segments:

- EEPROM Base Page: Selectable by connecting HW_SW_CTRL pin either to Logic 0 to Logic 1.
- EEPROM Page 0: Selectable by connecting HW_SW_CTRL pin to Logic 0.
- EEPROM Page 1: Selectable by connecting HW_SW_CTRL pin to Logic 1.

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Table 7-21. EEPROM Mapping[1][2][3][4]

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	1	1	1	R5[8]	R5[7]	R5[6]	R5[5]	R5[4]	R5[1]	R4[3]	R4[2]	R4[1]	R4[0]	R3[9]	R0[3]
1	0	1	0	0	1	0	0	0	0	1	1	1	1	1	R15[5]	1
2	0	0	0	1	1	0	1	1	0	0	0	1	0	0	1	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	R48[4]	R48[3]	R48[2]	R48[1]	R48[0]	R47[12]	R47[11]	R47[10]	R47[9]	R47[8]	R47[7]	0	0	0	0	0
5	0	R49[4]	R49[3]	R49[2]	R49[1]	R49[0]	R48[14]	R48[13]	R48[12]	R48[11]	R48[10]	R48[9]	R48[8]	R48[7]	R48[6]	R48[5]
6	0	0	0	R50[10]	R50[9]	R50[8]	1	1	0	0	0	0	0	0	0	0
7	R55[6]	R53[6]	1	R53[2]	R53[1]	R53[0]	1	0	1	0	0	0	0	0	0	0
8	1	0	0	0	0	0	1	R58[4]	R58[3]	R58[2]	R58[1]	R58[0]	0	R55[9]	R55[8]	R55[7]
9	0	1	R60[15]	R60[14]	R60[13]	R60[12]	R60[3]	R60[2]	R60[1]	R60[0]	R59[9]	R59[8]	R59[7]	R59[6]	R59[5]	R59[4]
10	R65[8]	R65[7]	R65[6]	R65[5]	R65[4]	1	0	0	0	0	R64[9]	R64[8]	R64[7]	R64[6]	R64[5]	0
11	0	0	0	R69[9]	R69[8]	R69[7]	R69[6]	R69[5]	0	0	1	R66[3]	R66[2]	R66[1]	R66[0]	R65[9]
12	R74[5]	0	0	1	R71[3]	R71[2]	R71[1]	R71[0]	R70[9]	R70[8]	R70[7]	R70[6]	R70[5]	R70[4]	1	0
13	R76[0]	R75[9]	R75[8]	R75[7]	R75[6]	R75[5]	R75[4]	1	0	0	0	0	R74[9]	R74[8]	R74[7]	R74[6]
14	0	0	0	0	0	R79[3]	R79[2]	R79[1]	R79[0]	R76[9]	R76[8]	R76[7]	R76[6]	R76[3]	R76[2]	R76[1]
15	0	0	0	0	0	0	R81[3]	1	0	0	0	0	0	0	R80[3]	0
16	R1[6]	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	R0[15]	R0[14]	R0[13]	R0[12]	0	R0[10]	0	R0[8]	R0[0]
17	R2[6]	R2[5]	R2[4]	R2[3]	R2[2]	R2[1]	R2[0]	R1[15]	R1[14]	R1[13]	R1[12]	R1[11]	R1[10]	R1[9]	R1[8]	R1[7]
18	0	R5[3]	R5[2]	R4[7]	R4[6]	R4[5]	R4[4]	R3[4]	R3[3]	R2[13]	R2[12]	R2[11]	R2[10]	R2[9]	R2[8]	R2[7]
19	R24[15]	R24[12]	R24[11]	R24[10]	R24[9]	R24[8]	0	0	R24[5]	R24[4]	R24[3]	R24[2]	R24[1]	R24[0]	0	0
20	R27[0]	0	R25[14]	R25[13]	R25[12]	R25[11]	R25[10]	R25[9]	R25[7]	R25[6]	R25[5]	R25[4]	R25[3]	R25[2]	R25[1]	R25[0]
21	R30[14]	R30[13]	R30[12]	R30[11]	R30[10]	R30[9]	R30[8]	R30[7]	R30[6]	R30[5]	R30[4]	R30[3]	R30[2]	R30[1]	R30[0]	R27[1]
22	R31[15]	R31[14]	R31[13]	R31[12]	R31[11]	R31[10]	R31[9]	R31[8]	R31[7]	R31[6]	R31[5]	R31[4]	R31[3]	R31[2]	R31[1]	R31[0]
23	R33[7]	R33[6]	R33[5]	R33[4]	R33[3]	R33[2]	R33[1]	R33[0]	R32[7]	R32[6]	R32[5]	R32[4]	R32[3]	R32[2]	R32[1]	R32[0]
24	R34[7]	R34[6]	R34[5]	R34[4]	R34[3]	R34[2]	R34[1]	R34[0]	R33[15]	R33[14]	R33[13]	R33[12]	R33[11]	R33[10]	R33[9]	R33[8]

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Table 7-21. EEPROM Mapping(1)(2)(3)(4) (continued)

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
25	R43[10]	R43[9]	R43[8]	R43[7]	R43[6]	R43[5]	R43[4]	R43[3]	R43[2]	R43[1]	R43[0]	R42[5]	R42[3]	R42[2]	R42[1]	R41[15]
26	R51[10]	0	0	1	R51[6]	0	0	R47[6]	R47[5]	R47[4]	R47[3]	R43[15]	R43[14]	R43[13]	R43[12]	R43[11]
27	R56[10]	R56[9]	R56[8]	R56[7]	R56[6]	R56[5]	R56[4]	R56[3]	R56[2]	R56[1]	R56[0]	R53[3]	1	0	0	0
28	R57[14]	R57[12]	R57[9]	R57[8]	R57[7]	R57[6]	R57[5]	R57[4]	R57[3]	R57[1]	R57[0]	R56[15]	R56[14]	R56[13]	R56[12]	R56[11]
29	R62[6]	R62[5]	R62[4]	R62[3]	R62[2]	R62[1]	R62[0]	R60[11]	R60[10]	R60[5]	R60[4]	R59[15]	R59[14]	R59[13]	R59[12]	R59[11]
30	R63[7]	R63[6]	R63[5]	R63[4]	R63[3]	R63[1]	R63[0]	R62[15]	R62[14]	R62[13]	R62[12]	R62[11]	R62[10]	R62[9]	R62[8]	R62[7]
31	R67[6]	R67[5]	R67[4]	R67[3]	R67[2]	R67[1]	R67[0]	R66[5]	R66[4]	R65[14]	R65[13]	R65[11]	R63[13]	R63[12]	R63[9]	R63[8]
32	R68[7]	R68[6]	R68[5]	R68[4]	R68[3]	R68[1]	R68[0]	R67[15]	R67[14]	R67[13]	R67[12]	R67[11]	R67[10]	R67[9]	R67[8]	R67[7]
33	R72[6]	R72[5]	R72[4]	R72[3]	R72[2]	R72[1]	R72[0]	R71[10]	R71[9]	R71[5]	R71[4]	R70[11]	R68[13]	R68[12]	R68[9]	R68[8]
34	R73[7]	R73[6]	R73[5]	R73[4]	R73[3]	R73[1]	R73[0]	R72[15]	R72[14]	R72[13]	R72[12]	R72[11]	R72[10]	R72[9]	R72[8]	R72[7]
35	0	0	0	R77[1]	R77[0]	R76[5]	R76[4]	R75[15]	R75[14]	R75[13]	R75[12]	R75[11]	R73[13]	R73[12]	R73[9]	R73[8]
36	0	0	0	0	0	0	0	0	0	R79[9]	R78[12]	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
40	R1[6]	R1[5]	R1[4]	R1[3]	R1[2]	R1[1]	R1[0]	R0[15]	R0[14]	R0[13]	R0[12]	0	R0[10]	0	R0[8]	R0[0]
41	R2[6]	R2[5]	R2[4]	R2[3]	R2[2]	R2[1]	R2[0]	R1[15]	R1[14]	R1[13]	R1[12]	R1[11]	R1[10]	R1[9]	R1[8]	R1[7]
42	0	R5[3]	R5[2]	R4[7]	R4[6]	R4[5]	R4[4]	R3[4]	R3[3]	R2[13]	R2[12]	R2[11]	R2[10]	R2[9]	R2[8]	R2[7]
43	R24[15]	R24[12]	R24[11]	R24[10]	R24[9]	R24[8]	0	0	R24[5]	R24[4]	R24[3]	R24[2]	R24[1]	R24[0]	0	0
44	R27[0]	0	R25[14]	R25[13]	R25[12]	R25[11]	R25[10]	R25[9]	R25[7]	R25[6]	R25[5]	R25[4]	R25[3]	R25[2]	R25[1]	R25[0]
45	R30[14]	R30[13]	R30[12]	R30[11]	R30[10]	R30[9]	R30[8]	R30[7]	R30[6]	R30[5]	R30[4]	R30[3]	R30[2]	R30[1]	R30[0]	R27[1]
46	R31[15]	R31[14]	R31[13]	R31[12]	R31[11]	R31[10]	R31[9]	R31[8]	R31[7]	R31[6]	R31[5]	R31[4]	R31[3]	R31[2]	R31[1]	R31[0]
47	R33[7]	R33[6]	R33[5]	R33[4]	R33[3]	R33[2]	R33[1]	R33[0]	R32[7]	R32[6]	R32[5]	R32[4]	R32[3]	R32[2]	R32[1]	R32[0]
48	R34[7]	R34[6]	R34[5]	R34[4]	R34[3]	R34[2]	R34[1]	R34[0]	R33[15]	R33[14]	R33[13]	R33[12]	R33[11]	R33[10]	R33[9]	R33[8]
49	R43[10]	R43[9]	R43[8]	R43[7]	R43[6]	R43[5]	R43[4]	R43[3]	R43[2]	R43[1]	R43[0]	R42[5]	R42[3]	R42[2]	R42[1]	R41[15]

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Table 7-21. EEPROM Mapping(1)(2)(3)(4) (continued)

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
50	R51[10]	0	0	1	R51[6]	0	0	R47[6]	R47[5]	R47[4]	R47[3]	R43[15]	R43[14]	R43[13]	R43[12]	R43[11]
51	R56[10]	R56[9]	R56[8]	R56[7]	R56[6]	R56[5]	R56[4]	R56[3]	R56[2]	R56[1]	R56[0]	R53[3]	1	0	0	0
52	R57[14]	R57[12]	R57[9]	R57[8]	R57[7]	R57[6]	R57[5]	R57[4]	R57[3]	R57[1]	R57[0]	R56[15]	R56[14]	R56[13]	R56[12]	R56[11]
53	R62[6]	R62[5]	R62[4]	R62[3]	R62[2]	R62[1]	R62[0]	R60[11]	R60[10]	R60[5]	R60[4]	R59[15]	R59[14]	R59[13]	R59[12]	R59[11]
54	R63[7]	R63[6]	R63[5]	R63[4]	R63[3]	R63[1]	R63[0]	R62[15]	R62[14]	R62[13]	R62[12]	R62[11]	R62[10]	R62[9]	R62[8]	R62[7]
55	R67[6]	R67[5]	R67[4]	R67[3]	R67[2]	R67[1]	R67[0]	R66[5]	R66[4]	R65[14]	R65[13]	R65[11]	R63[13]	R63[12]	R63[9]	R63[8]
56	R68[7]	R68[6]	R68[5]	R68[4]	R68[3]	R68[1]	R68[0]	R67[15]	R67[14]	R67[13]	R67[12]	R67[11]	R67[10]	R67[9]	R67[8]	R67[7]
57	R72[6]	R72[5]	R72[4]	R72[3]	R72[2]	R72[1]	R72[0]	R71[10]	R71[9]	R71[5]	R71[4]	R70[11]	R68[13]	R68[12]	R68[9]	R68[8]
58	R73[7]	R73[6]	R73[5]	R73[4]	R73[3]	R73[1]	R73[0]	R72[15]	R72[14]	R72[13]	R72[12]	R72[11]	R72[10]	R72[9]	R72[8]	R72[7]
59	0	0	0	R77[1]	R77[0]	R76[5]	R76[4]	R75[15]	R75[14]	R75[13]	R75[12]	R75[11]	R73[13]	R73[12]	R73[9]	R73[8]
60	0	0	0	0	0	0	0	0	0	R79[9]	R78[12]	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	SCRC[15]	SCRC[14]	SCRC[13]	SCRC[12]	SCRC[11]	SCRC[10]	SCRC[9]	SCRC[8]	SCRC[7]	SCRC[6]	SCRC[5]	SCRC[4]	SCRC[3]	SCRC[2]	SCRC[1]	SCRC[0]

(1) Address Locations 0-15: EEPROM Base Page
(2) Address Locations 16-39: EEPROM Page 0
(3) Address Locations 40-63: EEPROM Page 1
(4) Bit locations marked in Red can vary from device to device

Table 7-22. Register Defaults in Fall-Back Mode and EEPROM Mode

REGISTER ADDRESSES	FALL-BACK MODE	HW_SW_CTRL = 0	HW_SW_CTRL = 1	REGISTER ADDRESSES	FALL-BACK MODE	HW_SW_CTRL = 0	HW_SW_CTRL = 1
R85	x0000	x0000	x0000	**R42**	x0002	x0002	x0002
R84	x0000	x0000	x0000	**R41**	x0000	x0000	x0000
R83	x0FFC	xFD00	xFF00	**R40**	x0000	x0000	x0000
R82	x0600	x05C0	x05C0	**R39**	x0000	x0000	x0000
R81	x0004	x0004	x0004	**R38**	x0000	x0000	x0000
R80	x0000	x0000	x0000	**R37**	x0000	x0000	x0000
R79	x0008	x0208	x0208	**R36**	x0000	x0000	x0000
R78	x1000	x0000	x0000	**R35**	x0028	x0058	x0028
R77	x0000	x0000	x0000	**R34**	x0000	x0000	x0000
R76	x0008	x0008	x0008	**R33**	x0000	x0000	x0000
R75	x0008	x0008	x8008	**R32**	x0000	x0000	x0000
R74	xA181	xA181	xA181	**R31**	x0000	x0000	x0000
R73	x2000	x3000	x3000	**R30**	x0030	x0060	x0060
R72	x0006	x0006	x0006	**R29**	x0000	x0000	x0000
R71	x0000	x0000	x0000	**R28**	x0000	x0000	x0000
R70	x0008	x0008	x0008	**R27**	x0005	x0004	x0004
R69	xA181	xA181	xA181	**R26**	x0000	x0000	x0000
R68	x2000	x3000	x3000	**R25**	x0400	x0401	x0401

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Table 7-22. Register Defaults in Fall-Back Mode and EEPROM Mode (continued)

REGISTER ADDRESSES	FALL-BACK MODE	HW_SW_CTRL = 0	HW_SW_CTRL = 1	REGISTER ADDRESSES	FALL-BACK MODE	HW_SW_CTRL = 0	HW_SW_CTRL = 1
R67	x0006	x0006	x0006	**R24**	x0718	x0024	x0024
R66	x0000	x0000	x0000	**R23**	x0406	x2406	x2406
R65	x0008	x0008	x0008	**R22**	x00A0	x00A0	x00A0
R64	xA181	xA181	xA181	**R21**	x0585	x0590	x0593
R63	x2000	x3000	x3000	**R20**	x0000	x0000	x0000
R62	x0006	x0006	x0006	**R19**	x0000	x0000	x0000
R61	x0000	x0000	x0000	**R18**	x0000	x0000	x0000
R60	x0008	x0008	x0008	**R17**	x26C4	x26C4	x26C4
R59	x0008	x0008	x0008	**R16**	x921F	x921F	x921F
R58	x502C	x502C	x502C	**R15**	xA037	xA037	xA037
R57	x4000	x5000	x5000	**R14**	x0000	x0000	x0000
R56	x0006	x0006	x0006	**R13**	x0000	x0000	x0000
R55	x001E	x001E	x001E	**R12**	x0000	x0000	x0000
R54	x3400	x3400	x3400	**R11**	x0000	x0000	x0000
R53	x0069	x0069	x0069	**R10**	x0000	x0000	x0000
R52	x5000	x5000	x5000	**R9**	x0000	x03D4	x03D4
R51	x40C0	x40C0	x40C0	**R8**	x0001	x0001	x0001
R50	x01C0	x07C0	x07C0	**R7**	x0C0C	x0C2D	x0C2D
R49	x0013	x0013	x0013	**R6**	x19CA	x182C	x182C
R48	x1A14	x23C7	x23C7	**R5**	x0008	x0008	x0008
R47	x0A00	x0380	x0380	**R4**	x0000	x0000	x0000
R46	x0000	x0000	x0000	**R3**	x0000	x0200	x0200
R45	x4F80	x4F80	x4F80	**R2**	x0000	x0002	x0002
R44	x0318	x0318	x0318	**R1**	x2310	x7654	x7654
R43	x0051	x0051	x0051	**R0**	x1000	x0001	x0001

Table 7-23. Register Defaults in Fall-Back Mode and EEPROM Mode

REGISTER ADDRESSES	FALL-BACK MODE	HW_SW_CTRL = 0	HW_SW_CTRL = 1	REGISTER ADDRESSES	FALL-BACK MODE	HW_SW_CTRL = 0	HW_SW_CTRL = 1
R85	x0000	x0000	x0000	**R42**	x0002	x0002	x0000
R84	x0000	x0000	x0000	**R41**	x0000	x0000	x8000
R83	x0FFC	xFD00	xFD00	**R40**	x0000	x0000	x0000
R82	x0600	x01C0	x01C0	**R39**	x0000	x0000	x0000
R81	x0004	x0004	x0004	**R38**	x0000	x0000	x0000
R80	x0000	x0000	x0000	**R37**	x0000	x0000	x0000
R79	x0008	x0008	x0008	**R36**	x0000	x0000	x0000
R78	x1000	x0000	x0000	**R35**	x0028	x005C	x005B
R77	x0000	x0000	x0000	**R34**	x0000	x0000	x0000
R76	x0008	x0008	x0008	**R33**	x0000	x2710	x0000
R75	x0008	x0008	x0008	**R32**	x0000	x0000	x0000
R74	xA181	xA181	xA181	**R31**	x0000	x0000	x0000
R73	x2000	x2000	x2000	**R30**	x0030	x0064	x0064
R72	x0006	x0004	x0004	**R29**	x0000	x0000	x0000
R71	x0000	x0000	x0000	**R28**	x0000	x0000	x0000
R70	x0008	x0008	x0008	**R27**	x0005	x0004	x0007
R69	xA181	xA181	xA181	**R26**	x0000	x0000	x0000
R68	x2000	x2000	x2000	**R25**	x0400	x0401	x0401
R67	x0006	x0001	x0006	**R24**	x0718	x0018	x0124
R66	x0000	x0000	x0000	**R23**	x0406	x2406	x2406
R65	x0008	x0008	x0008	**R22**	x00A0	x00A2	x00A2
R64	xA181	xA181	xA181	**R21**	x0585	x0580	x0593
R63	x2000	x2000	x2000	**R20**	x0000	x0000	x0000
R62	x0006	x0005	x0005	**R19**	x0000	x0000	x0000
R61	x0000	x0000	x0000	**R18**	x0000	x0000	x0000

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Table 7-23. Register Defaults in Fall-Back Mode and EEPROM Mode (continued)

REGISTER ADDRESSES	FALL-BACK MODE	HW_SW_CTRL = 0	HW_SW_CTRL = 1	REGISTER ADDRESSES	FALL-BACK MODE	HW_SW_CTRL = 0	HW_SW_CTRL = 1
R60	x0008	x0008	x0008	**R17**	x26C4	x26C4	x26C4
R59	x0008	x0008	x0008	**R16**	x921F	x921F	x921F
R58	x502C	x502C	x502C	**R15**	xA037	xA037	xA037
R57	x4000	x4000	x4000	**R14**	x0000	x0000	x0000
R56	x0006	x0005	x0005	**R13**	x0000	x0000	x0000
R55	x001E	x03DE	x03DE	**R12**	x0000	x0000	x0000
R54	x3400	x3400	x3400	**R11**	x0000	x0000	x0000
R53	x0069	x0069	x0069	**R10**	x0000	x597F	x597F
R52	x5000	x5000	x5000	**R9**	x0000	x597F	x597F
R51	x40C0	x40C0	x4480	**R8**	x0001	x0001	x0001
R50	x01C0	x07C0	x07C0	**R7**	x0C0C	x0C0D	x0C0D
R49	x0013	x000A	x000A	**R6**	x19CA	x0AAC	x0AAC
R48	x1A14	x4BC1	x4BC1	**R5**	x0008	x0008	x0008
R47	x0A00	x00A8	x00A8	**R4**	x0000	x0040	x0040
R46	x0000	x0000	x0000	**R3**	x0000	x0200	x0200
R45	x4F80	x4F80	x4F80	**R2**	x0000	x0002	x0016
R44	x0318	x0318	x0318	**R1**	x2310	x2310	x0010
R43	x0051	x0051	x0051	**R0**	x1000	x1000	x0000

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8 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

8.1 Application Information

A typical application using the I²C interface and a 25MHz crystal input is shown in Figure 8-1. The two ends of 25MHz XTAL are connected to pin 1 and 2. The REFSEL pin is pulled down to select a secondary input. The HW_SW_CTRL can be pulled either low or high if EEPROM is used, or kept floating if EEPROM is unused. 1.8V, 2.5V, or 3.3V can be supplied to the VDD_REF and VDD_VCO pins, as well as VDDO_12 and VDDO_34 pins with filtering. Data and clock lines of I2C must be pulled to VDD_REF using pullup resistors. The PDN can be connected to the MCU if a hardware reset is required, otherwise the PDN can be left floating. The GPIO1 and 4 pins can be connected to the MCU if needed, otherwise these pins can be left floating. Unused outputs can be left floating.

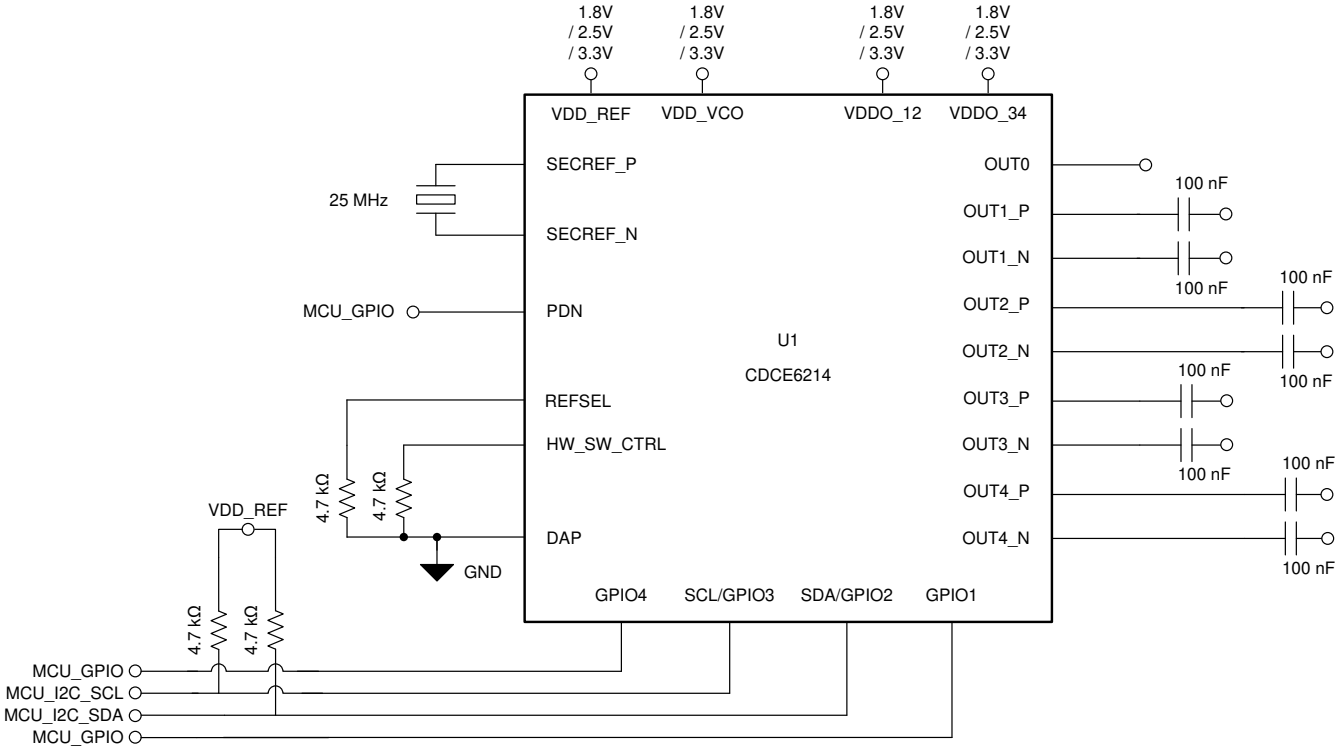


Figure 8-1. Typical Application Schematic With I²C Interface

8.2 Typical Application

Figure 8-2 shows typical block diagram for eAVB system using the CDCE6214-Q1.

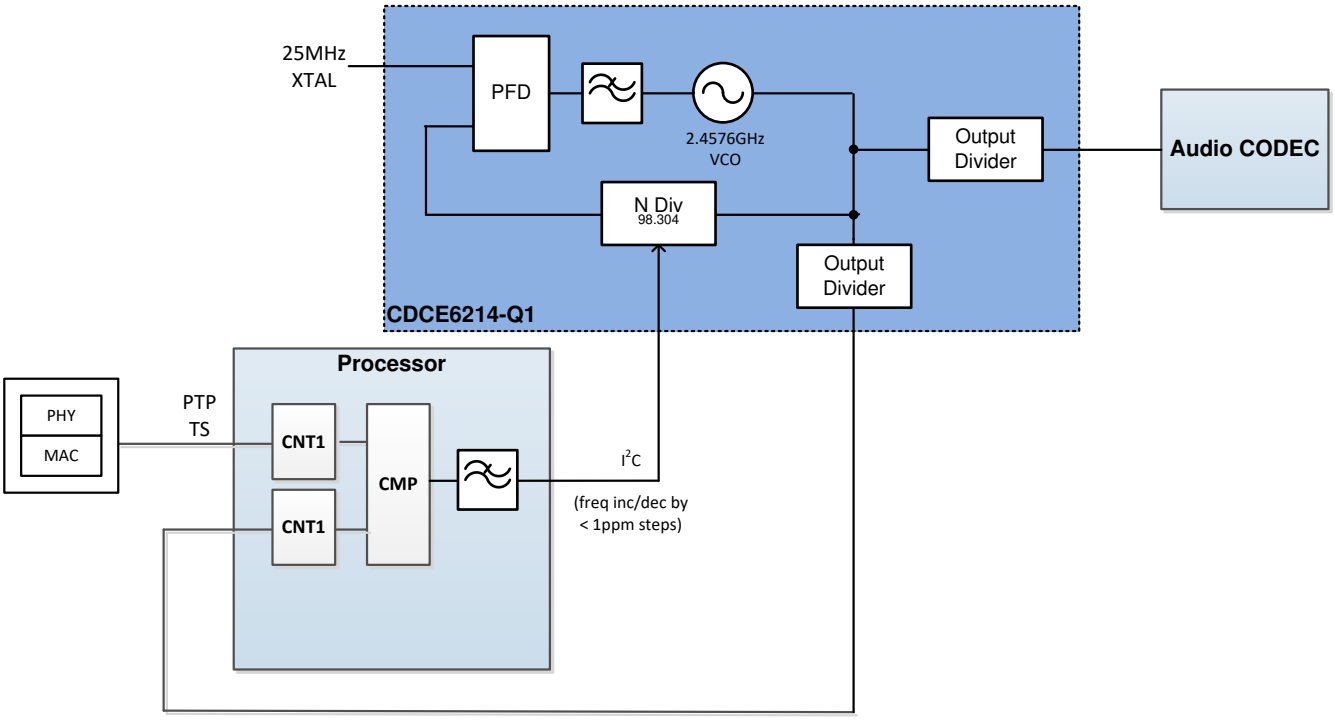


Figure 8-2. eAVB System Block Diagram Using CDCE6214-Q1

8.2.1 Design Requirements

For designs with the CDCE6214-Q1, the designer must select:

- a primary or secondary input
- an input type
- an input frequency
- a device communication mode (I^2C and/or EEPROM)
- the required device operation modes to configure the connections of GPIO pins
- a supply voltage (1.8V, 2.5V, or 3.3V)
- a digital reference (1.8V, 2.5V, or 3.3V)
- an output reference (1.8V, 2.5V, or 3.3V)
- an output format

8.2.2 Detailed Design Procedure

The CDCE6214-Q1 is designed for ease-of-use. To power up the device:

1. Either tie the power supply pin (VDD_REF, VDD_VCO, VDDO_12 and VDDO_34) together or independently connect the pins to the 1.8V, 2.5V, or 3.3V power supply.
2. Solder the GND Pin (DAP) to the PCB Plane.
3. Verify that the REFSEL, HW_SW_CTRL, and PDN configuration pins are appropriately connected:
   a. Internally connect the PDN pin to VDD_REF through a pullup resistor. When floating, the PDN pin automatically releases the device from PDN.
   b. If the PDN pin is low, the device does not respond to I^2C commands.
   c. REFSEL and HW_SW_CTRL are tri-level pins. If left floating, the device starts in fall-back mode.

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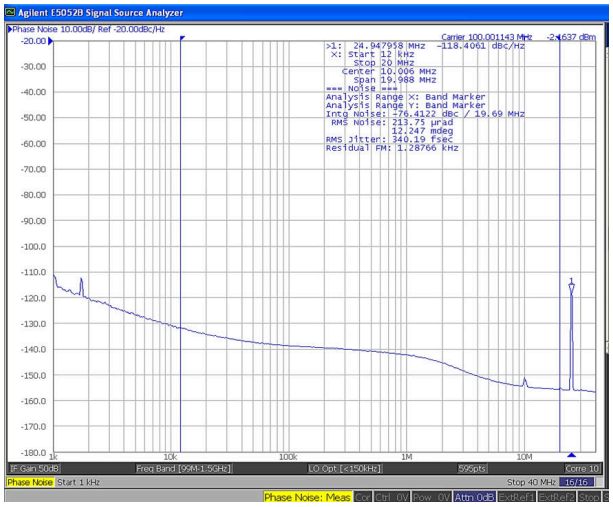
The device is factory-configured to provide:

- EEPROM Page 0: 100MHz LP-HCSL on all differential outputs using a 25MHz XTAL when HW_SW_CTRL = L. The 25MHz output on OUT0 is disabled. The device starts up in Pin Mode (no I^2C access).
- EEPROM Page 1: 100MHz LVDS on all differential outputs using a 25MHz XTAL and HW_SW_CTRL = H. The 25MHz output on OUT0 is disabled. The device starts up in Serial Interface Mode.
- Fall-Back Mode: 100MHz LP-HCSL on all differential outputs using a 25MHz XTAL, REFSEL = High-Z, and HW_SW_CTRL = High-Z. The 25MHz output on OUT0 is enabled and the PLL is *not* locked. The PLL must be recalibrated to achieve lock. The device starts up in Fall-Back Mode.

Note

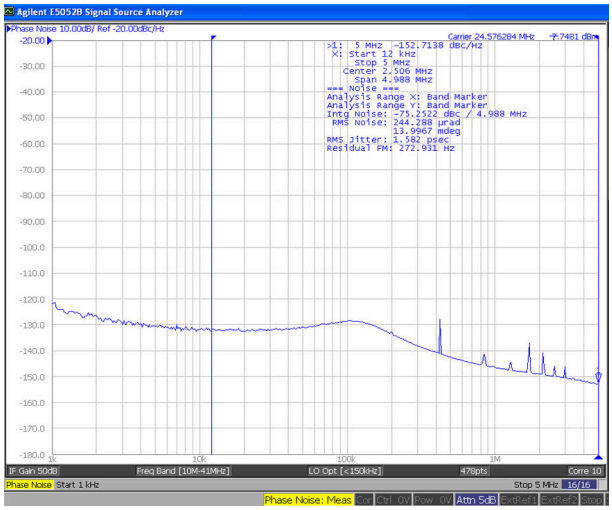
When selecting EEPROM Page 0 or 1, REF_SEL *must not* be left floating. REF_SEL must be pulled either High or Low for proper functionality.

8.2.3 Application Curves



Reference: Crystal Input 25MHz | Closed-Loop Phase Noise from 2.4GHz VCO | 100MHz LP-HCSL

Figure 8-3. 100MHz LP-HCSL Output for PCIe Application



Reference: Crystal Input 25MHz | Closed-Loop Phase Noise from 2.4576GHz VCO | 24.576MHz LVCMOS

Figure 8-4. 24.576MHz LVCMOS Output for Audio Clocking

8.3 Recommended Register Settings for PCIe Applications

For PCIe applications, Table 8-1, Table 8-2, and Table 8-3 describe the recommended register settings for best performance.

Table 8-1. Recommended Register Settings for PCIe Common Clock and Separate Reference, No SSC

Register	Value
R85	0x0000
R84	0x0000
R83	0x0000
R82	0x0000
R81	0x0004
R80	0x0000
R79	0x0008
R78	0x0000

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Table 8-1. Recommended Register Settings for PCIe Common Clock and Separate Reference, No SSC (continued)

Register	Value
R77	0x0000
R76	0x0008
R75	0x0008
R74	0xA181
R73	0x2000
R72	0x0006
R71	0x0000
R70	0x0008
R69	0xA181
R68	0x2000
R67	0x0006
R66	0x0000
R65	0x0008
R64	0xA181
R63	0x2000
R62	0x0006
R61	0x0000
R60	0x0008
R59	0x0008
R58	0x502C
R57	0x4000
R56	0x0006
R55	0x001E
R54	0x3400
R53	0x0069
R52	0x5000
R51	0x40C0
R50	0x07C0
R49	0x0013
R48	0x23C7
R47	0x0380
R46	0x0000
R45	0x4F80
R44	0x0318
R43	0x0051
R42	0x0002
R41	0x0000
R40	0x0000
R39	0x0000
R38	0x0000
R37	0x0000
R36	0x0000
R35	0x0000
R34	0x0000

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Table 8-1. Recommended Register Settings for PCIe Common Clock and Separate Reference, No SSC (continued)

Register	Value
R33	0x0000
R32	0x0000
R31	0x0000
R30	0x0060
R29	0x0000
R28	0x0000
R27	0x0004
R26	0x0000
R25	0x0401
R24	0x0024
R23	0x0000
R22	0x0000
R21	0x0000
R20	0x0000
R19	0x0000
R18	0x0000
R17	0x26C4
R16	0x921F
R15	0xA037
R14	0x0000
R13	0x0000
R12	0x0000
R11	0x0000
R10	0x0000
R9	0x0000
R8	0x0000
R7	0x0C0D
R6	0x0000
R5	0x0008
R4	0x0000
R3	0x0000
R2	0x0002
R1	0x2310
R0	0x1010

Table 8-2. Recommended Register Settings for PCIe Common Clock with Spread, -0.5% SSC

Register	Value
R85	0x0000
R84	0x0000
R83	0xFF00
R82	0x0DC0
R81	0x0004
R80	0x0000
R79	0x0008

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Table 8-2. Recommended Register Settings for PCIe Common Clock with Spread, -0.5% SSC (continued)

Register	Value
R78	0x0000
R77	0x0000
R76	0x0008
R75	0x0008
R74	0xA181
R73	0x2000
R72	0x0006
R71	0x0000
R70	0x0008
R69	0xA181
R68	0x2000
R67	0x0006
R66	0x0000
R65	0x0008
R64	0xA181
R63	0x2000
R62	0x0006
R61	0x0000
R60	0x0008
R59	0x0008
R58	0x502C
R57	0x4000
R56	0x0006
R55	0x001E
R54	0x3400
R53	0x0069
R52	0x5000
R51	0x4480
R50	0x07C0
R49	0x0013
R48	0x4BC1
R47	0x0080
R46	0x0000
R45	0x4F80
R44	0x0318
R43	0x0051
R42	0x0002
R41	0x8000
R40	0x0000
R39	0x0000
R38	0x0000
R37	0x0000
R36	0x0000
R35	0x0028
R34	0x0000

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Table 8-2. Recommended Register Settings for PCIe Common Clock with Spread, -0.5% SSC (continued)

Register	Value
R33	0x0000
R32	0x0000
R31	0x0000
R30	0x0060
R29	0x0000
R28	0x0000
R27	0x0006
R26	0x0000
R25	0x0401
R24	0x0024
R23	0x2406
R22	0x00A0
R21	0x0593
R20	0x0000
R19	0x0000
R18	0x0000
R17	0x26C4
R16	0x921F
R15	0xA037
R14	0x0000
R13	0x0000
R12	0x0000
R11	0x0000
R10	0x0000
R9	0x0000
R8	0x0001
R7	0x0C0F
R6	0x13EC
R5	0x0008
R4	0x0000
R3	0x0000
R2	0x0002
R1	0x2010
R0	0x1010

Table 8-3. Recommended Register Settings for PCIe Separate Reference Independent Spread, -0.25% SSC

Register	Value
R85	0x0000
R84	0x0000
R83	0xFF00
R82	0x0DC0
R81	0x0004
R80	0x0000
R79	0x0008

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Table 8-3. Recommended Register Settings for PCIe Separate Reference Independent Spread, -0.25% SSC (continued)

Register	Value
R78	0x0000
R77	0x0000
R76	0x0008
R75	0x0008
R74	0xA181
R73	0x2000
R72	0x0006
R71	0x0000
R70	0x0008
R69	0xA181
R68	0x2000
R67	0x0006
R66	0x0000
R65	0x0008
R64	0xA181
R63	0x2000
R62	0x0006
R61	0x0000
R60	0x0008
R59	0x0008
R58	0x502C
R57	0x4000
R56	0x0006
R55	0x001E
R54	0x3400
R53	0x0069
R52	0x5000
R51	0x4480
R50	0x07C0
R49	0x0013
R48	0x4BC1
R47	0x0080
R46	0x0000
R45	0x4F80
R44	0x0318
R43	0x0051
R42	0x0000
R41	0x8000
R40	0x0000
R39	0x0000
R38	0x0000
R37	0x0000
R36	0x0000
R35	0x0028

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Table 8-3. Recommended Register Settings for PCIe Separate Reference Independent Spread, -0.25% SSC (continued)

Register	Value
R34	0x0000
R33	0x0000
R32	0x0000
R31	0x0000
R30	0x0060
R29	0x0000
R28	0x0000
R27	0x0006
R26	0x0000
R25	0x0401
R24	0x0024
R23	0x2406
R22	0x00A0
R21	0x0593
R20	0x0000
R19	0x0000
R18	0x0000
R17	0x26C4
R16	0x921F
R15	0xA037
R14	0x0000
R13	0x0000
R12	0x0000
R11	0x0000
R10	0x0000
R9	0x0000
R8	0x0001
R7	0x0C0F
R6	0x13EC
R5	0x0008
R4	0x0000
R3	0x0000
R2	0x0002
R1	0x2010
R0	0x1010

8.4 Power Supply Recommendations

The CDCE6214-Q1 provides multiple power supply pins. Each power supply supports 1.8V, 2.5V, or 3.3V. Internal low-dropout regulators (LDO) source the internal blocks and allow each pin to be supplied with an individual supply voltage. The VDD_REF pin supplies the control pins and the serial interface. Therefore, any pullup resistors shall be connected to the same domain as VDD_REF. VDD_VCO powers all PLL blocks, VDDO_12 powers outputs OUT1 and OUT2, and VDDO_34 powers OUT0, OUT3, and OUT4.

VDD_REF and VDDO_34 can be used for level translation operation on OUT0.

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8.4.1 Power-Up Sequence

There are no restrictions from the device for applying power to the supply pins. From an application perspective, TI recommends to either apply all the VDDs at the same time or apply the VDDREF first. The digital core is connected to VDDREF and thus the settings of the EEPROM are applied automatically.

8.4.2 Decoupling

TI recommends isolating all power supplies using a ferrite bead and provide decoupling for each of the supplies. TI also recommends optimizing the decoupling for the respective layout, and consider the power supply impedance to optimize for the individual frequency plan.

An example for a decoupling per supply pin: 1x 4.7µF, 1x 470nF, and 1x 100nF.

8.5 Layout

8.5.1 Layout Guidelines

For this example, follow these guidelines:

- Isolate inputs and outputs using a GND shield. Figure 8-5 routes all inputs and outputs as differential pairs.
- Isolate outputs to adjacent outputs when generating multiple frequencies.
- Isolate the crystal area, connect the GND pads of the crystal package and flood the adjacent area. Figure 8-6 shows a foot print which supports multiple crystal sizes.
- Try to avoid impedance jumps in the fan-in and fan-out areas when possible.
- Use five VIAs to connect the thermal pad to a solid GND plane. Full-through VIAs are preferred.
- Place decoupling capacitors with small capacitance values very close to the supply pins. Try to place the capacitors very close on the same layer or directly on the backside layer. Larger values can be placed more far away. Figure 8-6 shows three decoupling capacitors close to the device. Ferrite beads are recommended to isolate the different frequency domains and the VDD_VCO domain.
- Preferably use multiple VIAs to connect wide supply traces to the respective power planes.

8.5.2 Layout Examples

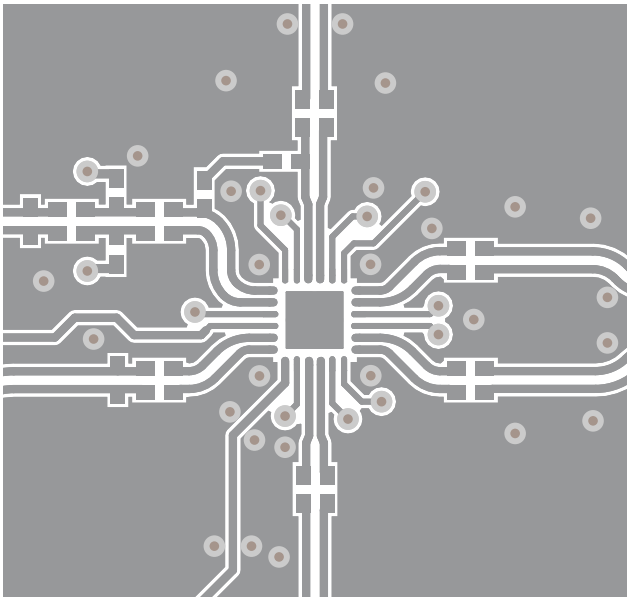


Figure 8-5. Layout Example, Top Layer

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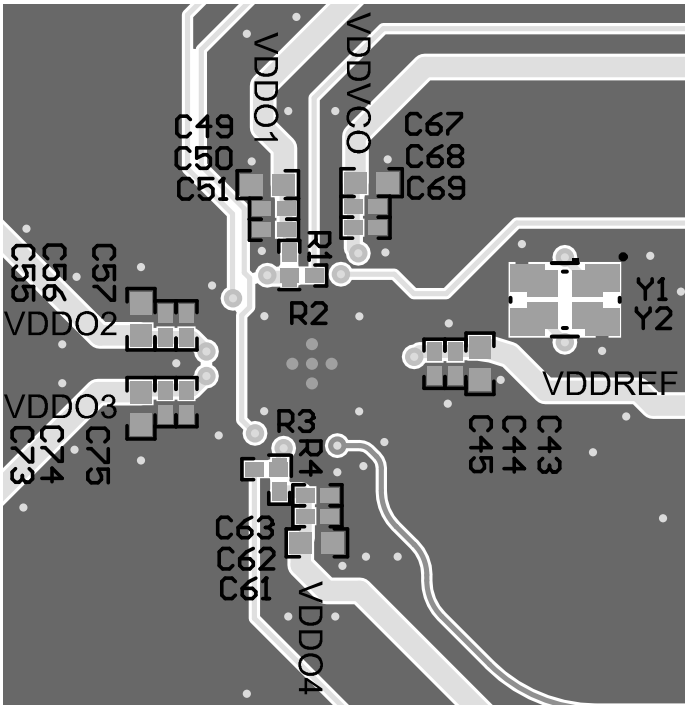


Figure 8-6. Layout Example, Bottom Layer

9 Device and Documentation Support

9.1 Device Support

9.1.1 Development Support

Contact your TI representative for more information.

9.1.2 Device Nomenclature

CDCE6214-Q1 – 62 = clock generator 1 = 1x PLL 4 = 4x outputs E = EEPROM, integer and fractional output dividers

9.2 Documentation Support

9.2.1 Related Documentation

For documentation related to the evaluation module, see also:

- Texas Instruments, CDCE6214-Q1 EVM User's Guide.

For documentation related to the register map, see also:

- Texas Instruments, CDCE6214-Q1 Register Map User's Guide.

9.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

9.4 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

9.5 Trademarks

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All trademarks are the property of their respective owners.

9.6 Electrostatic Discharge Caution



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.

9.7 Glossary

TI Glossary	This glossary lists and explains terms, acronyms, and definitions.

10 Revision History

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

Changes from Revision C (July 2025) to Revision D (November 2026)	Page
• Updated the *Closed-Loop Output Jitter Characteristic* table	7
• Updated recommendations for setting lock detect window. Lock detect window must be widened if dual PFD is used	23
• Updated description of single-ended and dual PFD operation	24

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- Added description of automatic VCO recalibration when DCO mode is enabled.....28

Changes from Revision B (October 2021) to Revision C (July 2025) **Page**

- Updated the numbering format for tables, figures, and cross-references throughout the document..... 1
- Updated PCIe Generation compliance in the *Features* section.....1
- Updated PCIe Generation compliance in the Applications section..... 1
- Deleted *Description (cont.)* section.....1
- Updated Package Information table..... 1
- Updated the "Type" footnote for the *Pin Functions* table to consolidate information.....4
- Updated capitalizations of letters throughout the Specifications section.....7
- Updated to clarify footnote (3) of Timing Requirements, I^2C-Compatible Serial Interface.....13
- Updated SSC_EN capabilities in the *Control Pins* section.....34
- Updated factory configurations in the *Detailed Design Procedure* section.....46
- Added the *Power Supply Recommendations* and *Layout* sections to the *Application and Implementation* section..... 53
- Updated *Layout Guidelines* to correct link to Figure 8-5..... 54
- Added references to EVM User's Guide and Register Map User Guide..... 56

Changes from Revision A (December 2019) to Revision B (October 2021) **Page**

- Added Functional Safety bullets to the *Features* section..... 1
- Updated the numbering format for tables, figures, and cross-references throughout the document..... 1
- Updated *Register Defaults in Fall-Back Mode and EEPROM Mode*.....39

Changes from Revision * (September 2024) to Revision A (September 2024) **Page**

- Updated the numbering format for tables, figures, and cross-references throughout the document..... 1
- Updated the output enable polarity.....1
- Updated *Register Defaults in Fall-Back Mode and EEPROM Mode*.....39

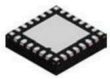
11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this datasheet, refer to the left-hand navigation.

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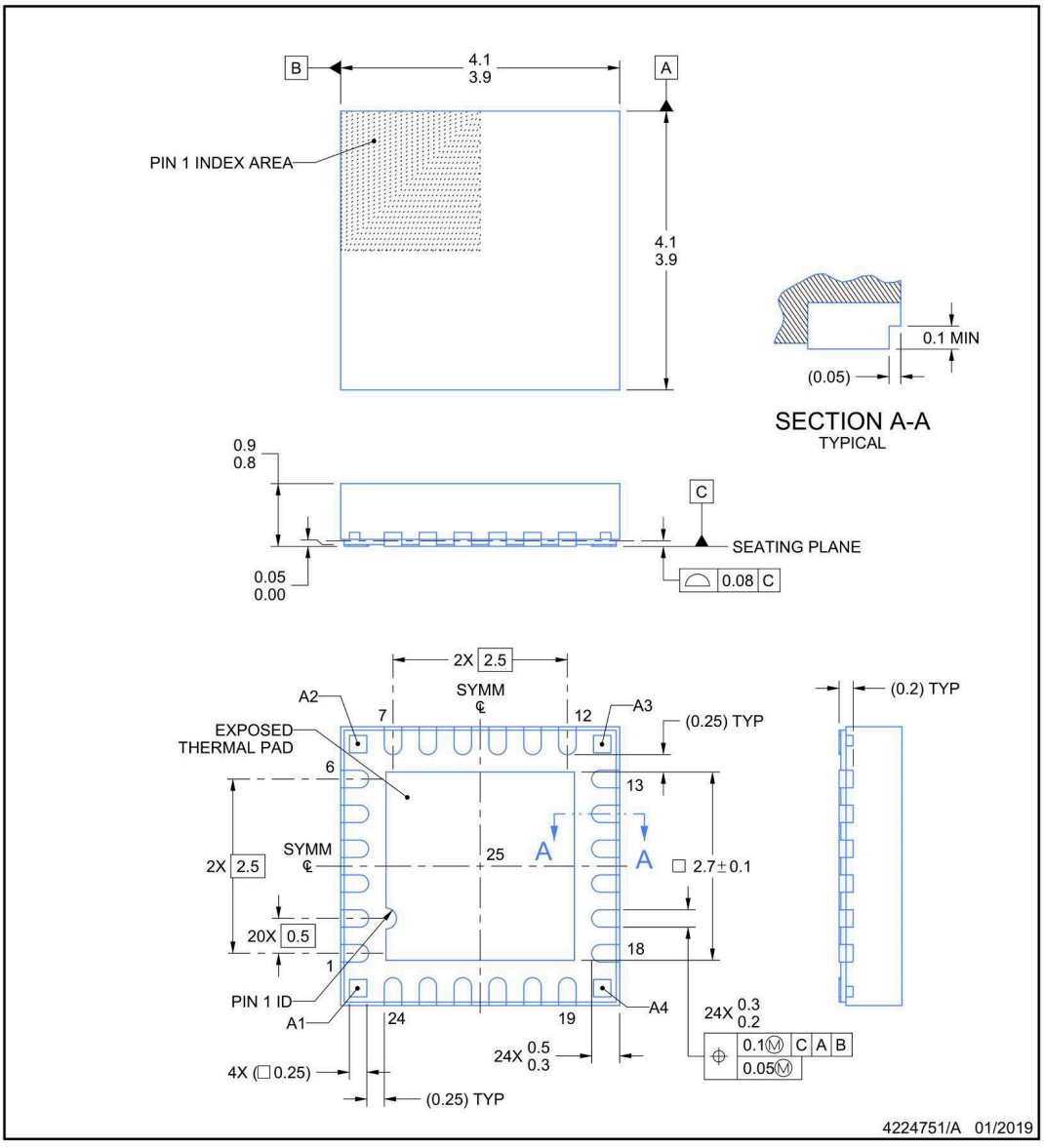
PACKAGE OUTLINE

RGE0024P



VQFN - 0.9 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES:

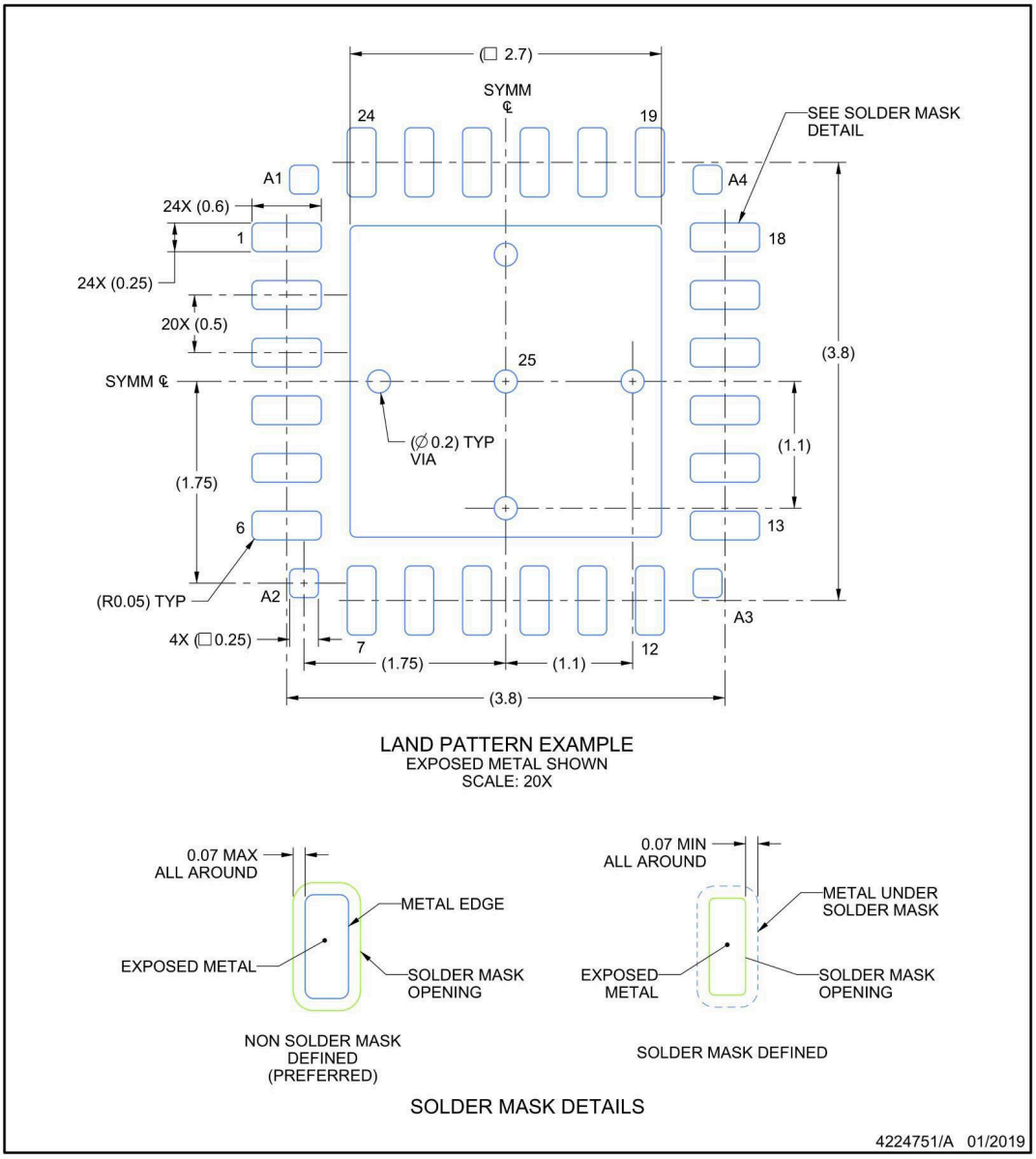
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

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EXAMPLE BOARD LAYOUT

RGE0024P — **VQFN - 0.9 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

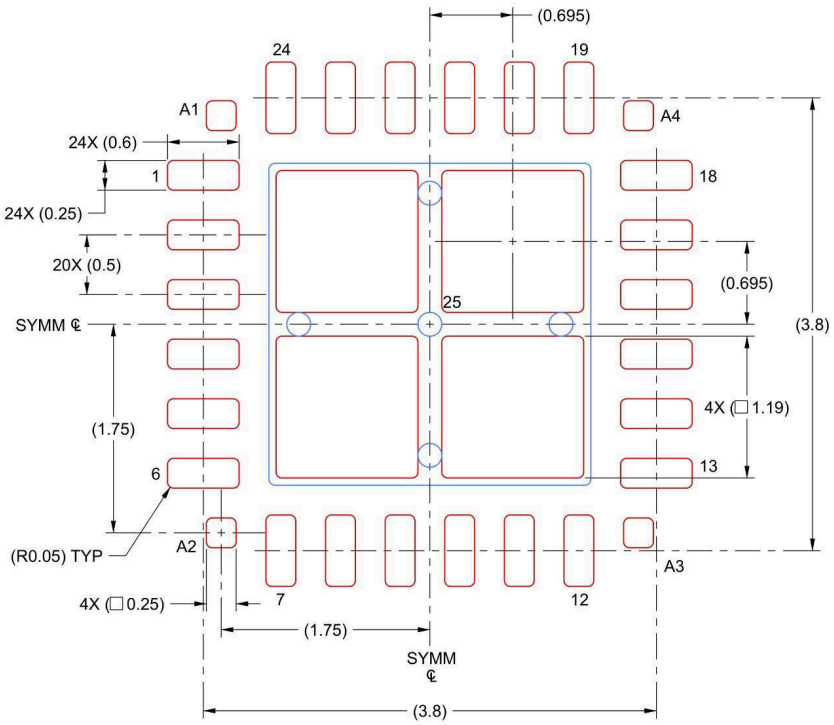
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

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EXAMPLE STENCIL DESIGN

RGE0024P — **VQFN - 0.9 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 20X

EXPOSED PAD 25
78% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4224751/A 01/2019

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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11.1 Package Option Addendum

Packaging Information

Orderable Device	Status[1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan[2]	Lead/Ball Finish[6]	MSL Peak Temp[3]	Op Temp (°C)	Device Marking[4][5]
CDCE6214TWRGERQ1	ACTIVE	VQFN	RGE	24	3000	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 105	6214Q1 A2Z
CDCE6214TWRGETQ1	ACTIVE	VQFN	RGE	24	250	RoHS & Green	SN	Level-2-260C-1 YEAR		6214Q1 A2Z

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PRE_PROD Unannounced device, not in production, not available for mass market, nor on the web, samples not available.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material).

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

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

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

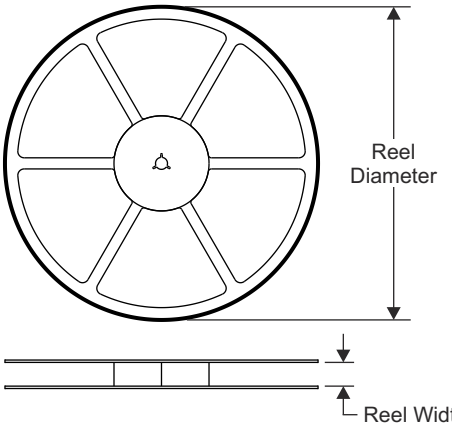
Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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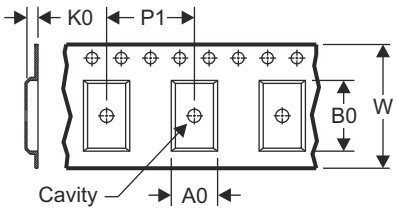
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11.2 Tape and Reel Information

REEL DIMENSIONS

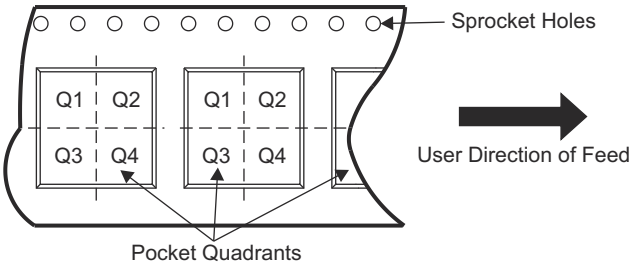


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

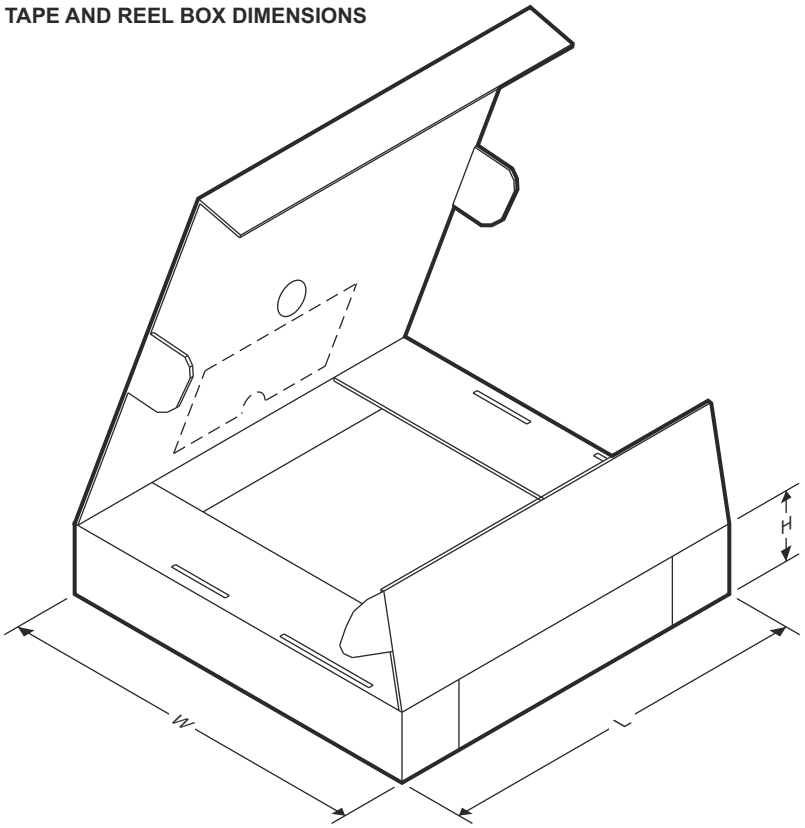
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CDCE6214TWRGERQ1	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDCE6214TWRGETQ1	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

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TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCE6214TWRGERQ1	VQFN	RGE	24	3000	346.0	346.0	33.0
CDCE6214TWRGETQ1	VQFN	RGE	24	250	210.0	185.0	35.0

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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)
CDCE6214TWRGERQ1	Active	Production	VQFN (RGE) | 24	3000 | LARGE T&R	Yes	Call TI | Sn	Level-2-260C-1 YEAR	-40 to 105	6214Q1 A2Z
CDCE6214TWRGERQ1.A	Active	Production	VQFN (RGE) | 24	3000 | LARGE T&R	Yes	Call TI	Level-2-260C-1 YEAR	-40 to 105	6214Q1 A2Z
CDCE6214TWRGETQ1	Active	Production	VQFN (RGE) | 24	250 | SMALL T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 105	6214Q1 A2Z
CDCE6214TWRGETQ1.A	Active	Production	VQFN (RGE) | 24	250 | SMALL T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 105	6214Q1 A2Z

(1) **Status:** For more details on status, see our product life cycle.

(2) **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.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **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.

(5) **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.

(6) **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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OTHER QUALIFIED VERSIONS OF CDCE6214-Q1 :

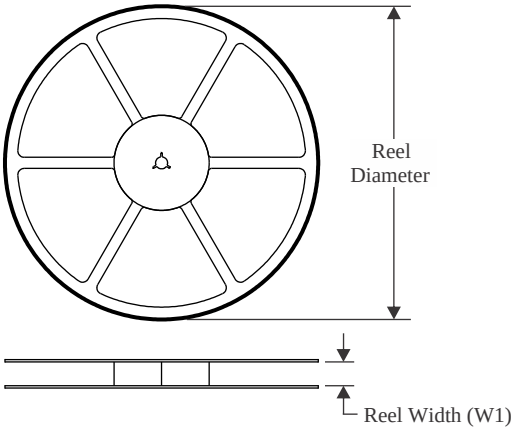
- Catalog : CDCE6214

NOTE: Qualified Version Definitions:

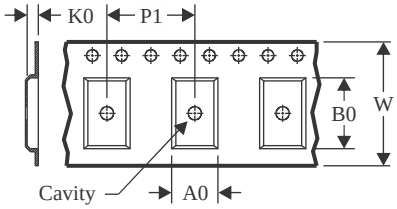
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

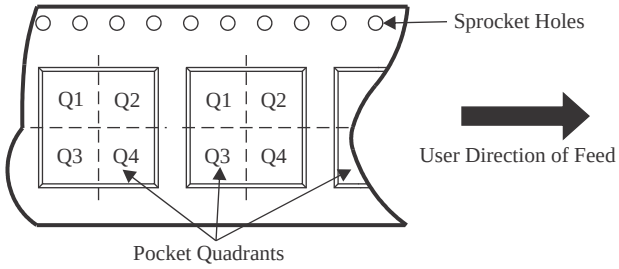


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

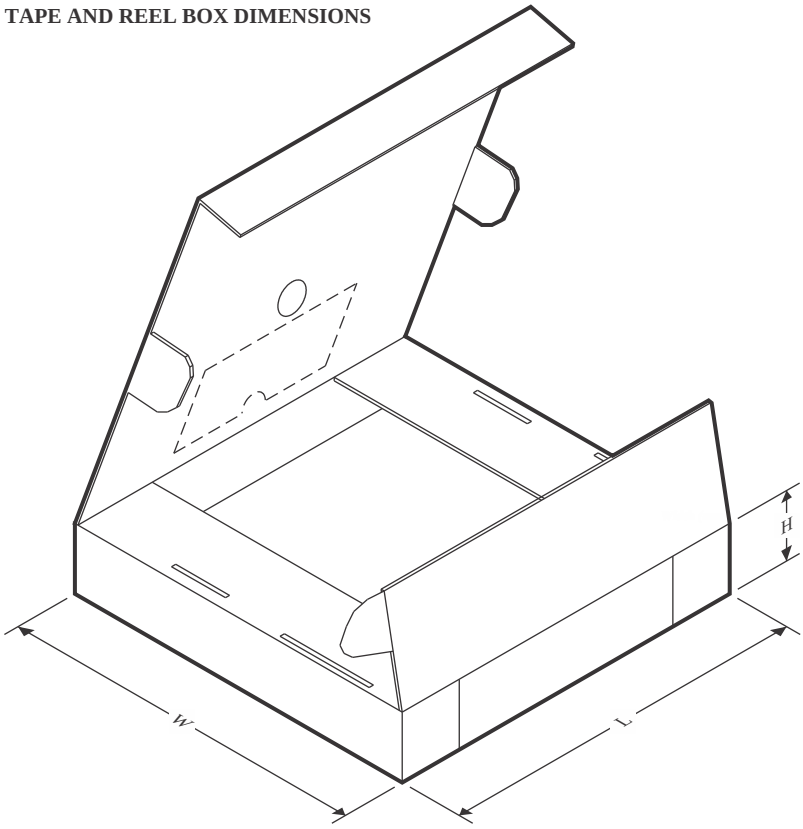
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CDCE6214TWRGERQ1	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDCE6214TWRGETQ1	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCE6214TWRGERQ1	VQFN	RGE	24	3000	346.0	346.0	33.0
CDCE6214TWRGETQ1	VQFN	RGE	24	250	210.0	185.0	35.0

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