A Product Line of
Diodes Incorporated

PI6CG336Q

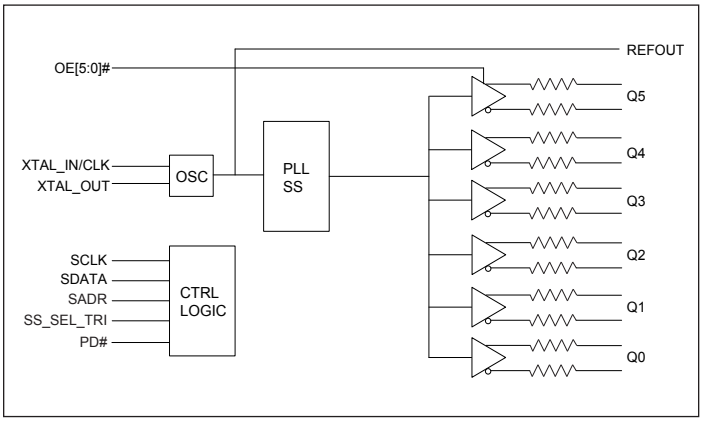
6-Output PCIe Gen 6 Clock Generator For Automotive Applications

Description

The DIODES PI6CG336Q is an 6-output very low power PCIe® Gen 1/Gen 2/Gen3 /Gen 4/Gen 5/Gen 6 clock generator. It uses 25MHz crystal or CMOS reference as an input to generate the 100MHz low power differential HCSL outputs with on-chip terminations. The on-chip termination can save 32 external resistors and make layout easier. An additional buffered reference output is provided to serve as a low noise reference for other circuitry.

It uses Diodes' proprietary PLL design to achieve very low jitter that meets PCIe Gen 1/Gen 2/Gen 3/Gen 4/Gen 5/Gen 6 requirements. It also provides various options such as different slew rate and amplitude through SMBUS so that users can configure the device easily to get the optimized performance for their individual boards. The device also supports selectable spread-spectrum options to reduce EMI for various applications.

Block Diagram



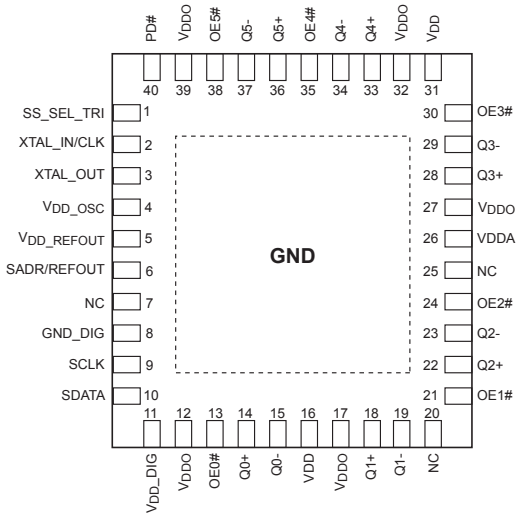
Features

- 3.3V Supply Voltage
- Crystal/CMOS Input: 25MHz
- 6 Differential Low Power HCSL Outputs with On-Chip Termination
- Individual Output Enable
- Reference CMOS Output
- Programmable Slew Rate and Output Amplitude for Each Output
- Differential Outputs Blocked Until PLL is Locked
- Selectable 0%, -0.25% or -0.5% Spread on Differential Outputs
- Strapping Pins or SMBus for Configuration
- Differential Output-To-Output Skew <60ps
- Very-Low Jitter Outputs
  - PCIe 6.0 Common Clock (RMS) Jitter <0.04ps
  - Differential Cycle-To-Cycle Jitter <50ps
  - CMOS REFOUT Phase Jitter
    - <0.3ps RMS, SSC Off
    - <1.5ps RMS, SSC On
- PCIe Gen 1/Gen 2/Gen 3/Gen 4/Gen 5/Gen 6 Compliant
- Supports Automotive Grade 2
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- The PI6CG336Q is suitable for automotive applications requiring specific change control; this part is AEC-Q100 qualified, PPAP capable, and manufactured in IATF 16949 certified facilities.
  https://www.diodes.com/quality/product-definitions/
- Packaging (Pb-free & Green):
  - 40-contact, 5×5mm (ZLW)

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. Automotive products are AEC-Q100 qualified and are PPAP capable. Refer to https://www.diodes.com/quality/.

Pin Configuration



Pin Description

Pin #	Pin Name	Type		Description
1	SS_SEL_TRI	Input	Tri-level	Latched select input to select spread spectrum amount at initial power up. 1 = -0.5% spread, M = Spread Off, 0 = Spread Off. This pin has both internal pull-up and pull-down. Refer to SMBUS byte_1 bit 4, 3 = '01' to get -0.25% spread.
2	XTAL_IN/CLK	Input		Crystal input or CMOS reference input
3	XTAL_OUT	Output		Crystal output
4	V_{DD}_OSC	Power		Power supply for oscillator circuitry, nominal 3.3V
5	V_{DD}_REFOUT	Power		Power supply for buffered CMOS output
6	SADR/REFOUT	Input/ Output	CMOS	Latch to select SMBus Address or LVCMOS REFOUT. This pin has an internal pull-down
7, 20, 25	NC			No connect
8	GND_DIG	Power		Ground for digital circuitry
9	SCLK	Input	CMOS	SMBUS clock input, 3.3V tolerant
10	SDATA	Input/ Output	CMOS	SMBUS Data line, 3.3V tolerant
11	V_{DD}_DIG	Power		Power supply for digital circuitry, nominal 3.3V
12, 17, 27, 32, 39	V_{DDO}	Power		Power supply for differential outputs
13	OE0#	Input	CMOS	Active low input for enabling Q0 pair. This pin has an internal pull-down. 1 = disable outputs, 0 = enable outputs
14	Q0+	Output	HCSL	Differential true clock output
15	Q0-	Output	HCSL	Differential complementary clock output

Pin #	Pin Name	Type		Description
18	Q1+	Output	HCSL	Differential true clock output
19	Q1-	Output	HCSL	Differential complementary clock output
21	OE1#	Input	CMOS	Active low input for enabling Q1 pair. This pin has an internal pull-down. 1 = disable outputs, 0 = enable outputs
16, 31	V_{DD}	Power		Power supply, nominal 3.3V
22	Q2+	Output	HCSL	Differential true clock output
23	Q2-	Output	HCSL	Differential complementary clock output
24	OE2#	Input	CMOS	Active low input for enabling Q2 pair. This pin has an internal pull-down. 1 = disable outputs, 0 = enable outputs
26	V_{DDA}	Power		Power supply for analog circuitry
28	Q3+	Output	HCSL	Differential true clock output
29	Q3-	Output	HCSL	Differential complementary clock output
30	OE3#	Input	CMOS	Active low input for enabling Q3 pair. This pin has an internal pull-down. 1 = disable outputs, 0 = enable outputs
33	Q4+	Output	HCSL	Differential true clock output
31	Q4-	Output	HCSL	Differential complementary clock output
35	OE4#	Input	CMOS	Active low input for enabling Q4 pair. This pin has an internal pull-down. 1 = disable outputs, 0 = enable outputs
36	Q5+	Output	HCSL	Differential true clock output
37	Q5-	Output	HCSL	Differential complementary clock output
38	OE5#	Input	CMOS	Active low input for enabling Q5 pair. This pin has an internal pull-down. 1 = disable outputs, 0 = enable outputs
40	PD#	Input	CMOS	Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode. This pin has internal pull-up resistor.

SMBus Address Selection Table

	SADR	Address	+Read/Write Bit
State of SADR on first application of PD#	0	1101000	X
	1	1101010	X

Power Management Table[3]

PD#	SMBus OE bit	OEn#	Qn+	Qn-	REFOUT
0	X	X	Low[1]	Low[1]	HiZ[2]
1	1	0	Running	Running	Running
1	1	1	Disabled[1]	Disabled[1]	Running
1	0	X	Disabled[1]	Disabled[1]	Disabled[4]

Note:

1. The output state is set by B11[1:0] (Low/Low default)
2. REF is Hi-Z until the 1st assertion of PD# high. After this, when PD# is low, REF is disabled. If Byte 3, bit 5 = 1, then REF is running
3. Input High/ Low defined at default values for device
4. See SMBUs Byte 3, bit 4

Maximum Ratings

(Above which useful life may be impaired. For user guidelines, not tested.)

Storage Temperature..... –65°C to +150°C
Supply Voltage to Ground Potential, V_{DDxx} .....–0.5V to +4.6V
Input Voltage ..... –0.5V to V_{DD}+0.5V, not exceed 4.6V
SMBus, Input High Voltage 3.6V
ESD Protection (HBM) 2000V
Max Junction Temperature .....+125°C

Note:
Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Operating Conditions

Temperature = T_A; Supply voltages per normal operation conditions; See test circuits for the load conditions

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
V_{DD}, V_{DDA}, V_{DD}_OSC, V_{DD}_DIG,	Power Supply Voltage		3.135	3.3	3.465	V
V_{DDO}	Output Power Supply Voltage		1.0	3.3	3.465	V
V_{DD_REFOUT}	Reference Output Power Supply Voltage		3.135	3.3	3.465	V
I_{DDA}	Analog Power Supply Current	All outputs active @100MHz		22	25	mA
I_{DD}	Power Supply Current	All V_{DD}, except V_{DDA} and V_{DDO}, All outputs active @100MHz		20	32	mA
I_{DDO}	Power Supply Current for Outputs(3)	All outputs active @100MHz		29	34	mA
I_{DDA_WL}	Analog Power Supply Wake-on-LAN(1) Current	Q outputs off, REF output running		0.5	1	mA
I_{DD_WL}	Power Supply Wake-on-LAN(1) Current	All V_{DD}, except V_{DDA} and V_{DDO}, Q outputs off, REF output running		3	6	mA
I_{DDO_WL}	Power Supply Wake-on-LAN(1) Current for Outputs	Q outputs off, REF output running		0.04	0.1	mA
I_{DDA_PD}	Analog Power Supply Power Down(2) Current	All outputs off		0.5	1	mA
I_{DD_PD}	Power Supply Power Down(2) Current	All outputs off		1	2	mA
I_{DDO_PD}	Power Supply Current Power Down(2) for Outputs	All outputs off		0.05	0.1	mA
T_A	Ambient Temperature	Automotive grade	–40		105	°C

Note:
1. Wake-on-LAN mode: PD# = '0' Byte 3, bit 5 = '1'
2. Power down mode: PD# = '0' Byte 3, bit 5 = '0'
3. Output drive 5 inch trace.

Input Electrical Characteristics

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
R_{pu}	Internal pull up resistance			120		KΩ
R_{dn}	Internal pull down resistance			120		KΩ
C_{XTAL}	Internal capacitance on X_IN and X_OUT pins			8		pF
L_{PIN}	Pin inductance				7	nH

Crystal Characteristic

Parameters	Description	Min.	Typ	Max.	Units
OSCmode	Mode of Oscillation		Fundamental		
FREQ	Frequency		25		MHz
ESR(1)	Equivalent Series Resistance			50	Ω
Cload	Load Capacitance		8		pF
Cshunt	Shunt Capacitance			7	pF
	Drive Level			200	uW

Note:

1. ESR value is dependent upon frequency of oscillation

SMBus Electrical Characteristics

Temperature = T_A; Supply voltages per normal operation conditions; See test circuits for the load conditions

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
V_{DDSMB}	Nominal bus voltage		2.7		3.6	V
V_{IHSMB}	SMBus Input High Voltage	SMBus, V_{DDSMB} = 3.3V	2.1		3.6	V
		SMBus, V_{DDSMB} < 3.3V	0.65 V_{DDSMB}			
V_{ILSMB}	SMBus Input Low Voltage	SMBus, V_{DDSMB} = 3.3V			0.8	V
		SMBus, V_{DDSMB} < 3.3V			0.8	
$I_{SMBSINK}$	SMBus sink current	SMBus, at V_{OLSMB}	4			mA
V_{OLSMB}	SMBus Output Low Voltage	SMBus, at $I_{SMBSINK}$			0.4	V
f_{MAXSMB}	SMBus operating frequency	Maximum frequency			500	kHz
t_{RMSB}	SMBus rise time	(Max V_{IL} - 0.15) to (Min V_{IH} + 0.15)			1000	ns
t_{FMSB}	SMBus fall time	(Min V_{IH} + 0.15) to (Max V_{IL} - 0.15)			300	ns

Spread Spectrum Characteristic

Temperature = T_A; Supply voltages per normal operation conditions; See test circuits for the load conditions

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
f_{MOD}	SS Modulation Frequency	Triangular modulation	30	31.8	33	kHz

LVCMOS DC Electrical Characteristics

Temperature = T_A; Supply voltages per normal operation conditions; See test circuits for the load conditions

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
V_{IH}	Input High Voltage	Single-ended inputs, except SMBus	0.75 V_{DD}		V_{DD} +0.3	V
V_{IM}	Input Mid Voltage	SS_SEL_TRI	$0.4V_{DD}$	$0.5V_{DD}$	$0.6V_{DD}$	V
V_{IL}	Input Low Voltage	Single-ended inputs, except SMBus	-0.3		0.25 V_{DD}	V
I_{IH}	Input High Current	Single-ended inputs, $V_{IN} = V_{DD}$			5	µA
I_{IL}	Input Low Current	Single-ended inputs, $V_{IN} = 0V$	-5			µA
I_{IH}	Input High Current	Single-ended inputs with pull up / pull down resistor, $V_{IN} = V_{DD}$			50	µA
I_{IL}	Input Low Current	Single-ended inputs with pull up / pull down resistor, $V_{IN} = 0V$	-50			µA
V_{OH}	Output High Voltage	REFOUT, except SMBus; I_{OH} = -2mA	0.8 x V_{DD_REFOUT}			V
V_{OL}	Output Low Voltage	REFOUT, except SMBus; I_{OL} = 2mA			0.2 x V_{DD_REFOUT}	V
R_{OUT}	CMOS Output impedance			20		Ω
C_{IN}	Input Capacitance		1.5		5	pF

LVCMOS AC Characteristics

Temperature = T_A; Supply voltages per normal operation conditions; See test circuits for the load conditions

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
f_{INPUT}	Input Frequency	XTAL_IN/CLK		25		MHz
t_{RIN}	Input rise time	Single-ended inputs			5	ns
t_{FIN}	Input fall time	Single-ended inputs			5	ns
t_{STAB}	Clock stabilization	From Power-Up and after input clock stabilization or de-assertion of PD# to 1st clock		0.75	1	ms
t_{OELAT}	Output enable latency	Q start after OE# assertion Q stop after OE# deassertion	1		3	clocks

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
t_{PDLAT}	PD# de-assertion	Differential outputs enable after PD# de-assertion		25	300	us
t_{PERIOD}	REFOUT clock period	REFOUT, assume input is at 25MHz		40		ns
f_{ACC}	REFOUT frequency accuracy(1)	REFOUT, long term accuracy to input		0		ppm
t_{SLEW}	REFOUT slew rate(1)	Byte 3 = 1F, 20% to 80% of V_{DDREF}	0.8	1.4	2	V/ns
		Byte 3 = 5F, 20% to 80% of V_{DDREF}	1.2	2.4	3.2	V/ns
		Byte 3 = 9F, 20% to 80% of V_{DDREF}	1.4	3	3.8	V/ns
		Byte 3 = DF, 20% to 80% of V_{DDREF}	1.9	3.2	4	V/ns
t_{DC}	REFOUT Duty Cycle(1)	V_T = V_{DD} /2 V, driven by a Xtal	45	50	55	%
t_{DCDIS}	REFOUT Duty Cycle Distortion	V_T = V_{DD} /2 V, driven by an external source	-2	0	+2	%
t_{JITCC}	REFOUT cycle-cycle jitter	V_T = V_{DD} /2 V, driven by a Xtal		70	150	ps
t_{JITPH}	REFOUT Phase Jitter, RMS	12kHz to 5MHz, SSC off, driven by a Xtal		0.16	0.3	ps
		12kHz to 5MHz, SSC on, driven by a Xtal		0.9	1.5	ps
t_{JITN}	Noise floor	1kHz offset, driven by a Xtal		-149	-135	dBc/Hz
		10kHz offset to Nyquist, driven by a Xtal		-158	-140	dBc/Hz

Note:

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

HCSL Output Characteristics

Temperature = T_A; Supply voltages per normal operation conditions; See test circuits for the load conditions

Symbol	Parameters	Condition	Min.	Typ.	Max.	Units
V_{OH}	Output Voltage High(1)	Statistical measurement on single-ended signal using oscilloscope math function	660	784	850	mV
V_{OL}	Output Voltage Low(1)		-150		150	mV
V_{OMAX}	Output Voltage Maximum(1)	Measurement on single ended signal using absolute value		816	1150	mV
V_{OMIN}	Output Voltage Minimum(1)		-300	-42		mV
V_{OC}	Output Cross Voltage(1,2,4)		250	430	550	mV
DV_{OC}	V_{OC} Magnitude Change(1,2,5)			30	140	mV

Note:

1. At default SMBUS amplitude settings
2. Guaranteed by design and characterization, not 100% tested in production
3. Measured from differential waveform
4. This one is defined as voltage where Q+ = Q- measured on a component test board and only applied to the differential rising edge
5. The total variation of all Vcross measurements in any particular system. This is a subset of Vcross_min/max allowed.

HCSL Output AC Characteristics

Temperature = T_A; Supply voltages per normal operation conditions; See test circuits for the load conditions

Symbol	Parameters	Condition	Min.	Typ.	Max.	Spec Limit	Units
f_{OUT}	Output Frequency			100			MHz
t_{RF}	Slew rate(1,2,3)	Scope averaging on fast setting	2.5	3.2	4		V/ns
		Scope averaging on slow setting	2.2	3	3.7		V/ns
Dt_{RF}	Slew rate matching(1,2,4)	Scope averaging on		7	15		%
t_{DC}	Duty Cycle(1,2)	Measured differentially, PLL Mode	45	50	55		%
t_{SKEW}	Output Skew(1,2)	Averaging on, V_T = 50%		20	60		ps
tj_{c-c}	Cycle to cycle jitter(1,2)			20	50		ps
tj_{PHASE}	Integrated Phase Jitter (RMS) (1,5)	PCIe 1.0(6) (2.5 Gb/s)		20	30	86	ps(p-p)
		PCIe 2.0 (5 Gb/s)		0.5	0.6	3.1	ps
		PCIe 3.0 (8 Gb/s)		0.32	0.42	1.0	ps
		PCIe 4.0 (16 Gb/s)		0.32	0.4	0.5	ps
		PCIe 5.0 (32 Gb/s)		0.05	0.06	0.15	ps
		PCIe 6.0 (64Gb/s)		0.03	0.04	0.1	ps
$tj_{PH-SRISG2}$	Integrated Phase Jitter (RMS)	PCIe 2.0 (5 Gb/s)		0.6	0.92	N/A	ps
$tj_{PH-SRISG3}$	Integrated Phase Jitter (RMS)	PCIe 3.0 (8 Gb/s)		0.5	0.6	N/A	ps
$tj_{PH-SRISG4}$	Integrated Phase Jitter (RMS)	PCIe 4.0 (16 Gb/s)		0.4	0.5	N/A	ps
$tj_{PH-SRISG5}$	Integrated Phase Jitter (RMS)	PCIe 5.0 (32 Gb/s)		0.06	0.07	N/A	ps
$tj_{PH-SRISG6}$	Integrated Phase Jitter (RMS)	PCIe 6.0 (64Gb/s)		0.04	0.05	N/A	ps

Note:

1. Guaranteed by design and characterization—not 100% tested in production.
2. Measured from differential waveform.
3. Slew rate is measured through the Vswing voltage range centered around differential 0V, within ±150mV window.
4. It is measured using a ±75mV window centered on the average cross point.
5. See http://www.pcisig.com for complete specs.
6. Sample size of at least 100k cycles. This can be extrapolated to 108ps pk-pk @ 1M cycles for a BER of 10^{-12}.

SMBus Serial Data Interface

The PI6CG336Q is a slave only device that supports block read and block write protocol using a single 7-bit address and read/write bit as shown below.

Read and write block transfers can be stopped after any complete byte transfer.

Address Assignment

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

Note: SMBus address is latched on SADR pin

How to Write

1 bit	7 bits	1 bit	1 bit	8 bits	1 bit	8 bits	1 bit	8 bits	1 bit		8 bits	1 bit	1 bit
Start bit	Add.	W(0)	Ack	Beginning Byte location = N	Ack	Data Byte count = X	Ack	Beginning Data Byte (N)	Ack	.....	Data Byte (N+X-1)	Ack	Stop bit

How to Read

1 bit	7 bits	1 bit	1 bit	8 bits	1 bit	1 bit	7 bits	1 bit	1 bit	8 bits	1 bit	8 bits	1 bit
Start bit	Address	W(0)	Ack	Beginning Byte location = N	Ack	Repeat Start bit	Address	R(1)	Ack	Data Byte count = X	Ack	Beginning Data Byte (N)	Ack

	8 bits	1 bit	1 bit
.....	Data Byte (N+X-1)	NAck	Stop bit

Byte 0: Output Enable Register

Bit	Control Function	Description	Type	Power Up Condition	0	1
7	Q5_OE	Q5 output enable	RW	1	See B11[1:0]	Pin Control
6	Q4_OE	Q4 output enable	RW	1		Pin Control
5	Reserved			0		Pin Control
4	Q3_OE	Q3 output enable	RW	1		Pin Control
3	Q2_OE	Q2 output enable	RW	1		Pin Control
2	Q1_OE	Q1 output enable	RW	1		Pin Control
1	Reserved			0		Pin Control
0	Q0_OE	Q0 output enable	RW	1		Pin Control

Note:

1. A low on these bits will override the OE# pins and force the differential outputs to the state indicated by B11[1:0] (Low/ Low default)

Byte 1: SS Spread Spectrum and Control Register						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	SSENRB1	SS Enable Readback Bit1	R	Latch	'00' for SS_SEL_TRI = '0', '10' for SS_SEL_TRI = 'M' '11' for SS_SEL_TRI = '1'	
6	SSENRB0	SS Enable Readback Bit0	R	Latch		
5	SSEN_SWCTR	Enable SW control of SS	RW	0	Values in B1[7:6] control SS amount	Values in B1[4:3] control SS amount
4	SSENSW1	SS enable SW control Bit1	RW(1)	0	'00' = SS off, '01' = -0.25% SS, '10' = SS off, '11' = -0.5% SS	
3	SSENSW0	SS enable SW control Bit0	RW(1)	0		
2	Reserved			1		
1	Amplitude1	Control output amplitude	RW	1	'00' = 0.6V, '01' = 0.68V, '10' = 0.75V, '11' = 0.85V	
0	Amplitude0		RW	0		

Note:

1. Spread must be selected OFF or ON with the hardware latch pin. These bits should not be used to turn spread ON or OFF after power up. These bits can be used to change the spread amount, and B1[5] must be set to a 1 for these bits to have any effect on the part. If These bits are used to turn spread OFF or ON, the system will need to be reset.

Byte 2: Differential Output Slew Rate Control Register						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	SLEWRATECTR_Q5	Control slew rate of Q5	RW	1	Slow setting	Fast setting
6	SLEWRATECTR_Q4	Control slew rate of Q4	RW	1	Slow setting	Fast setting
5	Reserved			1		
4	SLEWRATECTR_Q3	Control slew rate of Q3	RW	1	Slow setting	Fast setting
3	SLEWRATECTR_Q2	Control slew rate of Q2	RW	1	Slow setting	Fast setting
2	SLEWRATECTR_Q1	Control slew rate of Q1	RW	1	Slow setting	Fast setting
1	Reserved			1		
0	SLEWRATECTR_Q0	Control slew rate of Q0	RW	1	Slow setting	Fast setting

Byte 3: REF Control Register						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	REFSLEWRATE	Slew rate control for REF	RW	0	'00' = 1.4V/ns '01' = 2.4V/ns,	
6			RW	1	'10' = 3V/ns, '11' = 3.2V/ns	
5	REF_PDSTATE	Wake-on-Lan enable for REF	RW	0	REF = Disabled in PD state(1)	REF = running in PD state
4	REF_OE	Output enable for REF	RW	1	REF = Disabled(1)	REF = running
3	Reserved			1		
2	Reserved			1		
1	Reserved			1		
0	Reserved			1		

Note:

1. The disabled state depends on Byte11[1:0]. '00' = Low, '01'=HiZ, '10'=Low, '11'=High

Byte 4: Reserved						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7:0	Reserved			0x40		

Byte 5: Revision and Vendor ID Register						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	RID3	Revision ID	R	0	rev = 0000	
6	RID2		R	0		
5	RID1		R	0		
4	RID0		R	0		
3	PVID3	Vendor ID	R	0	Diodes = 0011	
2	PVID2		R	0		
1	PVID1		R	1		
0	PVID0		R	1		

Byte 6: Device Type/Device ID Register						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	DTYPE1	Device type	R	0	'00' = CG, '01' = ZDB,	
6	DTYPE0		R	0	'10' = Reserve, '11' = NZDB	
5	DID5	Device ID	R	0	001000 binary, 08Hex	
4	DID4		R	0		
3	DID3		R	1		
2	DID2		R	0		
1	DID1		R	0		
0	DID0		R	0		

Byte 7: Byte Count Register						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	Reserved			0		
6	Reserved			0		
5	Reserved			0		
4	BC4	Byte count programming	RW	0	Writing to this register will configure how many bytes will be read back, default is 8 bytes	
3	BC3		RW	1		
2	BC2		RW	0		
1	BC1		RW	0		
0	BC0		RW	0		

Byte 8 and 9: Reserved						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7:0	Reserved			B8 = 0x36 B9 = 0x00		

Byte 10: PD Restore						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	Reserved			0		
6	PD Restore	PD Restore to default configuration	RW	1	Clear PD Config	Keep PD Config
5:0	Reserved			0		

Byte 11: Stop Control						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7:2	Reserved			0		
1	STP1	True/ Compliment DIF Output Disable Sate	RW	0	00 = Low/Low	10 = High/ Low
0	STP0		RW	0	01 = HiZ/HiZ	11 = Low/ High

Byte 12: Impedance Control						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	Q2_Zout1	Q2 Zout	RW	10	00 = Reserved 01 = 85Ω 10 = 100Ω 11 = Reserved	
6	Q2_Zout0	Q2 Zout	RW			
5	Q1_Zout1	Q1 Zout	RW			
4	Q1_Zout0	Q1 Zout	RW			
3	Reserved					
2	Reserved					
1	Q0_Zout1	Q0 Zout	RW			
0	Q0_Zout0	Q0 Zout	RW			

Byte 13: Impedance Control						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	Q5_Zout1	Q5 Zout	RW	10	00 = Reserved 01 = 85Ω 10 = 100Ω 11 = Reserved	
6	Q5_Zout0	Q5 Zout	RW			
5	Q4_Zout1	Q4 Zout	RW			
4	Q4_Zout0	Q4 Zout	RW			
3	Reserved		RW			
2	Reserved		RW			
1	Q3_Zout1	Q3 Zout	RW			
0	Q3_Zout0	Q3 Zout	RW			

Byte 14: OE Termination Control						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	OE2_term1	OE2 Pull up or down	RW	0	00 = None	10 = Pullup
6	OE2_term0	OE2 Pull up or down	RW	1	01 = Pull-down	11 = Pullup and Down
5	OE1_term1	OE1 Pull up or down	RW	0	00 = None	10 = Pullup
4	OE1_term0	OE1 Pull up or down	RW	1	01 = Pull-down	11 = Pullup and Down
3	Reserved			0		
2	Reserved			1		
1	OE0_term1	OE0 Pull up or down	RW	0	00 = None	10 = Pullup
0	OE0_term0	OE0 Pull up or down	RW	1	01 = Pull-down	11 = Pullup and Down

Byte 15: OE Termination Control						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	OE5_term1	OE5 Pull up or down	RW	0	00 = None	10 = Pullup
6	OE5_term0	OE5 Pull up or down	RW	1	01 = Pull-down	11 = Pullup and Down
5	OE4_term1	OE4 Pull up or down	RW	0	00 = None	10 = Pullup
4	OE4_term0	OE4 Pull up or down	RW	1	01 = Pull-down	11 = Pullup and Down
3	Reserved			0		
2	Reserved			1		
1	OE3_term1	OE3 Pull up or down	RW	0	00 = None	10 = Pullup
0	OE3_term0	OE3 Pull up or down	RW	1	01 = Pull-down	11 = Pullup and Down

Byte 16: Power Good Termination Control						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7:2	Reserved					
1	PWRGD_PD1	Clock Power Good and Power Down Pull up or Pull down	RW	1	00 = None	10 = Pullup
0	PWRGD_PD0		RW	0	01 = Pull-down	11 = Pullup and Down

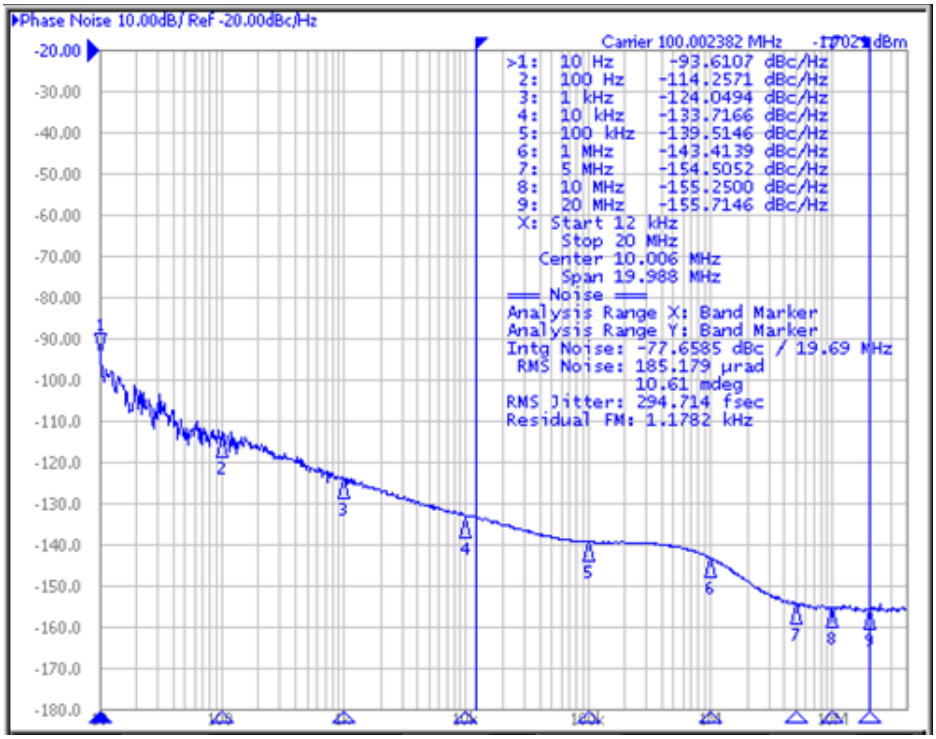
Byte 17: Reserved

Byte 18: Enable Pin Control						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7	OE5_Enable	Sets Enable High or Low	RW	0	Enable = Low	Enable = High
6	OE4_Enable	Sets Enable High or Low	RW	0	Enable = Low	Enable = High
5	Reserved			0	Enable = Low	Enable = High
4	OE3_Enable	Sets Enable High or Low	RW	0	Enable = Low	Enable = High
3	OE2_Enable	Sets Enable High or Low	RW	0	Enable = Low	Enable = High
2	OE1_Enable	Sets Enable High or Low	RW	0	Enable = Low	Enable = High
1	Reserved			0	Enable = Low	Enable = High
0	OE0_Enable	Sets Enable High or Low	RW	0	Enable = Low	Enable = High

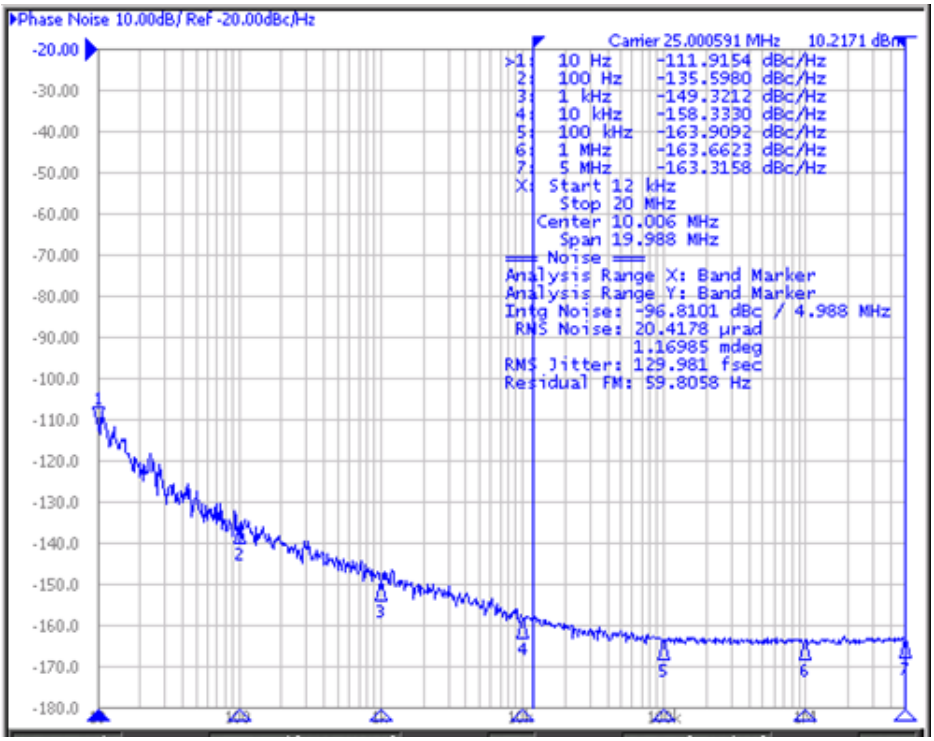
Byte 19: Power Down Pin Control						
Bit	**Control Function**	**Description**	**Type**	**Power Up Condition**	**0**	**1**
7:1	Reserved			0		
0	PWRGD_PD	PWRGD_PD Active via Pull up or Pull down	RW	0	Power Down = Low	Power Down = High

Phase Noise Plots

100MHz HCSL Clock (12k to 20MHz)



25MHz CMOS Clock



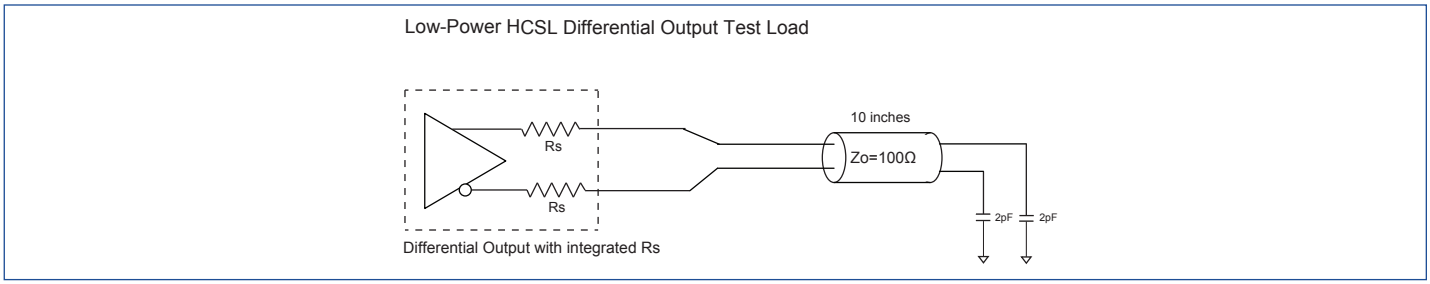


Figure 1. Low Power HCSL Test Circuit

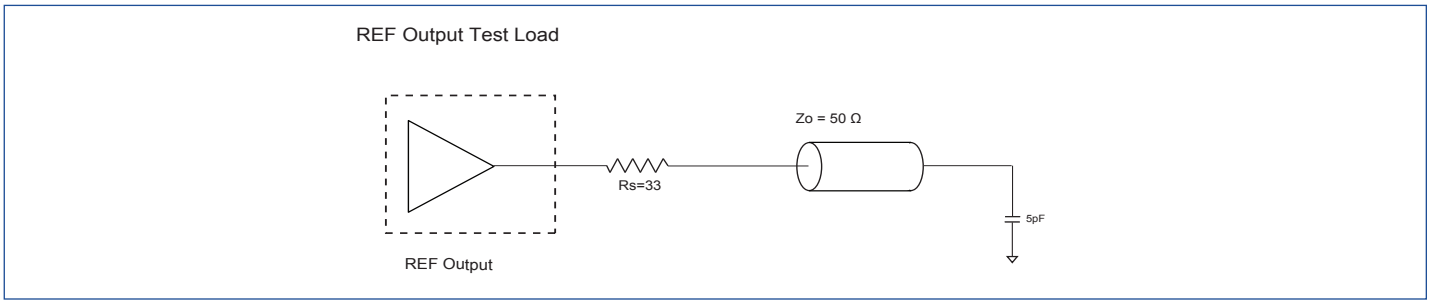


Figure 2. CMOS REF Test Circuit

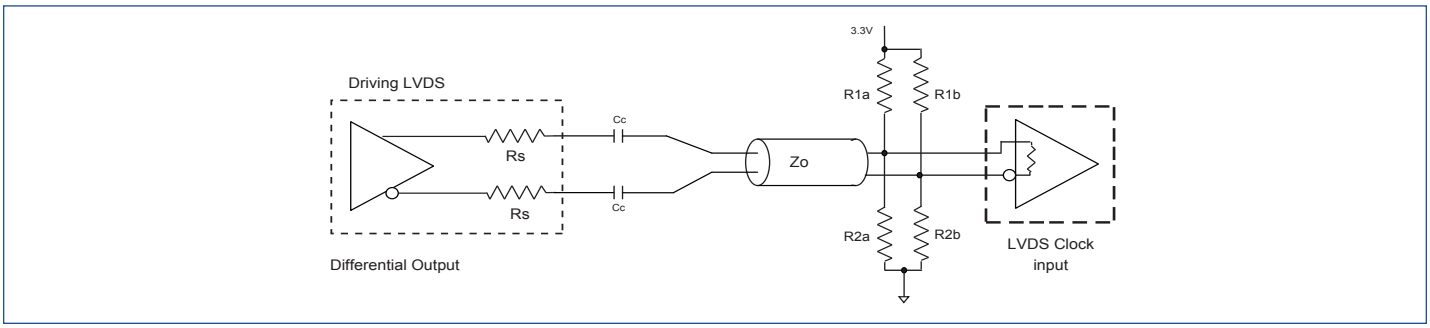


Figure 3. Differential Output driving LVDS

Alternate Differential Output Terminations

Component	Receiver with Termination	Receiver without Termination	Unit
R_{1a}, R_{1b}	10,000	140	Ω
R_{2a}, R_{2b}	5,600	75	Ω
C_C	0.1	0.1	µF
V_{CM}	1.2	1.2	V

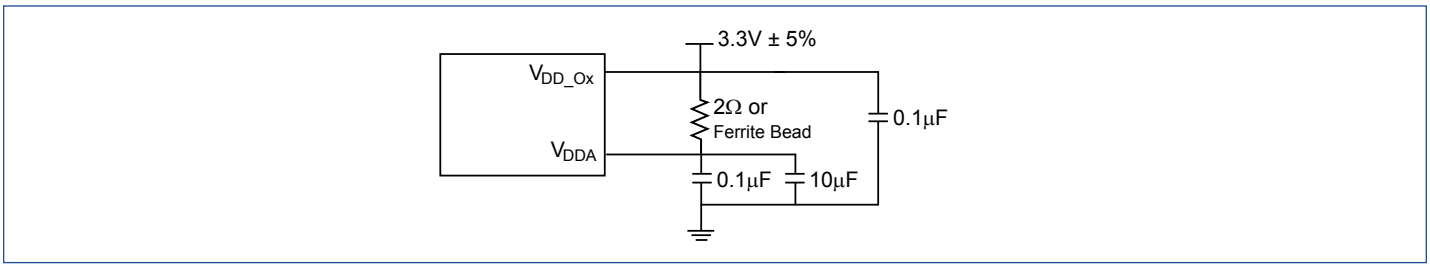
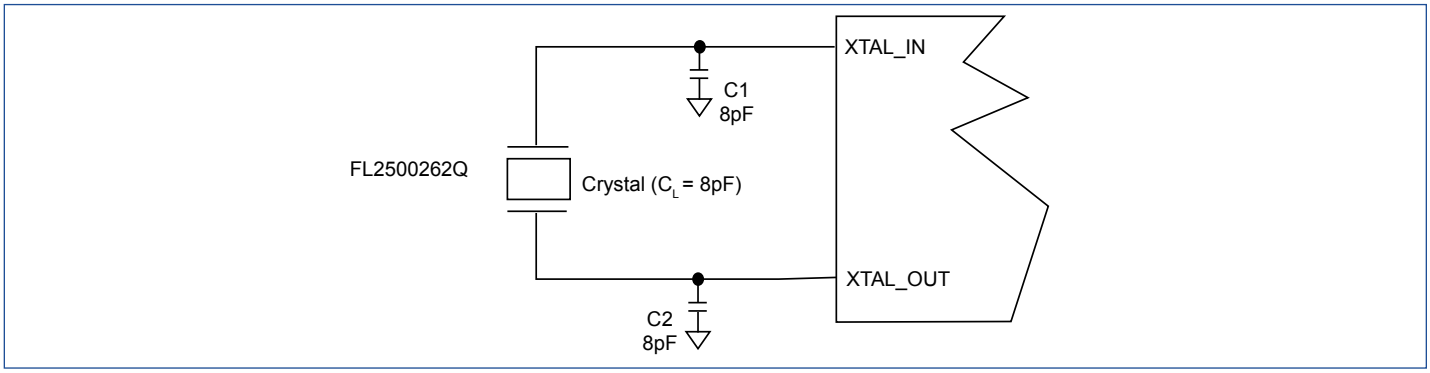


Figure 4. Power Supply Filter

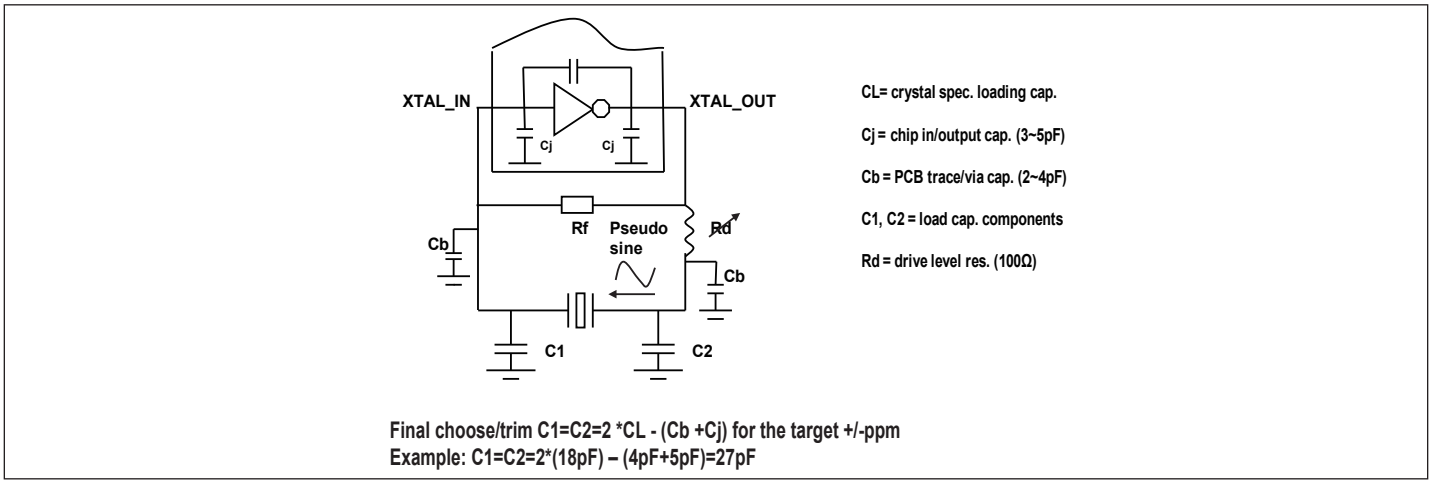
Crystal Circuit Connection

The following diagram shows PI6CG336Q crystal circuit connection with a parallel crystal. For the CL=8pF crystal, it is suggested to use C1=8pF, C2=8pF. C1 and C2 can be adjusted to fine tune to the target ppm of crystal oscillator according to different board layouts based on the following formular in the Crystal Capacitor Calculation diagram.

Crystal Oscillator Circuit



Crystal Capacitor Calculation



Recommended Crystal Specification

Diodes Recommends:

a) FL2500262Q, SMD 3.2x2.5(4P), 25MHz, CL=8pF, ±50ppm, https://www.diodes.com/assets/Datasheets/FL.pdf.

b) FW2500054Q, SMD 2.0x1.6(4P), 25MHz, CL=8pF, ±50ppm, https://www.diodes.com/assets/Datasheets/FW.pdf.

Thermal Characteristics

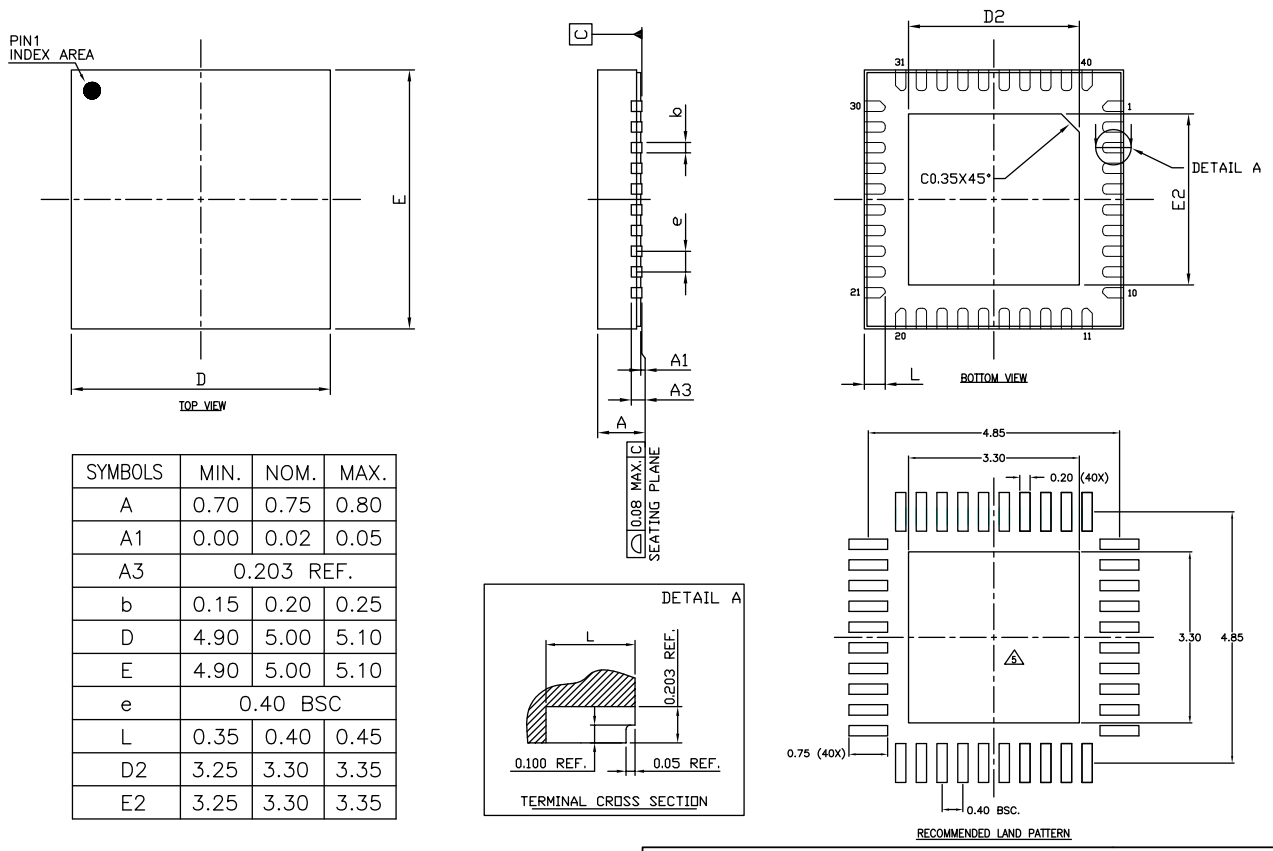
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
θ_{JA}	Thermal Resistance Junction to Ambient	Still air			38.15	°C/W
θ_{JC}	Thermal Resistance Junction to Case				24.66	°C/W

Part Marking

YY: Year
WW: Workweek
1st X: Assembly Code
2nd X: Fab Code

Packaging Mechanical

40-WQFN (ZLW)



SYMBOLS	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3		0.203 REF.	
b	0.15	0.20	0.25
D	4.90	5.00	5.10
E	4.90	5.00	5.10
e		0.40 BSC	
L	0.35	0.40	0.45
D2	3.25	3.30	3.35
E2	3.25	3.30	3.35

NOTE :
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
3. REFER JEDEC MO-220.
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.
5. THERMAL PAD SOLDERING AREA (MESH STENCIL DESIGN IS RECOMMENDED)
6. SWP STANDS FOR SIDEWALL PLATING

DATE: 07/29/22

DESCRIPTION: W-QFN5050-40/SWP

PACKAGE CODE: ZLW (ZLW40)

DOCUMENT CONTROL #: PD-2279 REVISION: --

For latest package info.

please check: http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/

Ordering Information

Ordering Code	Package Code	Package Description	Operating Temperature
PI6CG336Q2ZLWEX	ZLW	W-QFN5050-40 (SWP)	-40°C to 105°C

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. Q = Automotive Compliant
5. 2 = AEC-Q100 Grade Level
6. E = Pb-free and Green
7. X suffix = Tape/Reel

IMPORTANT NOTICE

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.

3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.

4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.

5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.

7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.

8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.

9. This Notice may be periodically updated with the most recent version available at https://www.diodes.com/about/company/terms-and-conditions/important-notice

www.diodes.com