Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Si53360/61/62/65 Data Sheet

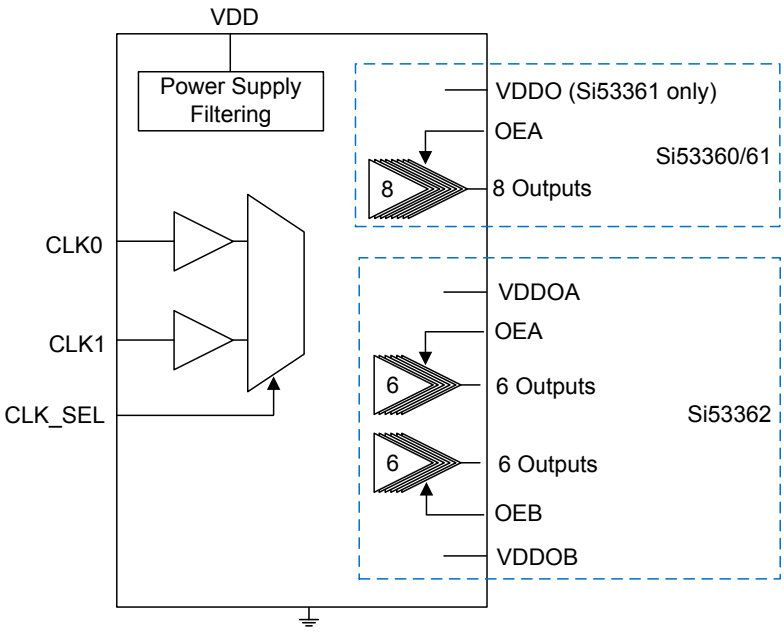
Low-Jitter, LVCMOS Fanout Clock Buffers with up to 12 outputs and Frequency Range from dc to 200 MHz

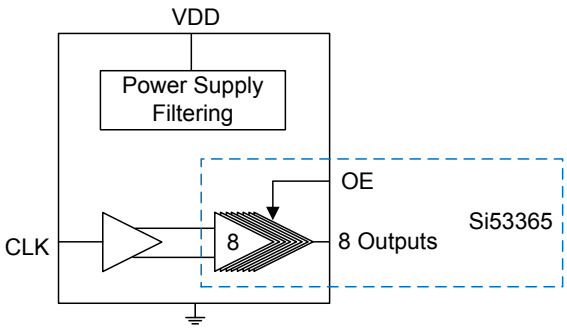
The Si53360/61/62/65 family of LVCMOS fanout buffers is ideal for clock/data distribution and redundant clocking applications. The family utilizes Silicon Labs advanced CMOS technology to fanout clocks from dc to 200 MHz with guaranteed low additive jitter, low skew, and low propagation delay variability. Built-in LDOs deliver high PSRR performance and eliminates the need for external components simplifying low jitter clock distribution in noisy environments.

The CMOS buffers are available in multiple configurations with 8 outputs (Si53360/61/65), or dual banks of 6 outputs each (Si53362). These buffers can be paired with the Si534x clock generators and Si5xx oscillators to deliver end-to-end clock tree performance.

KEY FEATURES

- Low additive jitter: 120 fs rms
- Built-in LDOs for high PSRR performance
- Up to 12 LVCMOS Outputs from LVCMOS inputs
- Frequency range: dc to 200 MHz
- Multiple configuration options
  - Dual Bank option
  - 2:1 Input MUX option
- RoHS compliant, Pb-free
- Temperature range: –40 to +85 °C





1. Ordering Guide

Table 1.1. Si5336x Ordering Guide

Part Number	Input	LVCMOS Output	Output Enable	Frequency Range	Package
Si53360-B-GT	2:1 selectable MUX LVCMOS	1 bank / 8 Outputs	Single	dc to 200 MHz	16-TSSOP
Si53361-B-GM	2:1 selectable MUX LVCMOS	1 bank / 8 Outputs (Settable VDDO)	Single	dc to 200 MHz	16-QFN 3x3 mm
Si53362-B-GM	2:1 selectable MUX LVCMOS	2 banks / 6 Outputs	1 per bank	dc to 200 MHz	24-QFN 4x4 mm
SI53365-B-GT	1 bank / 1 Input LVCMOS	1 bank / 8 Outputs	Single	dc to 200 MHz	16-TSSOP

2. Functional Description

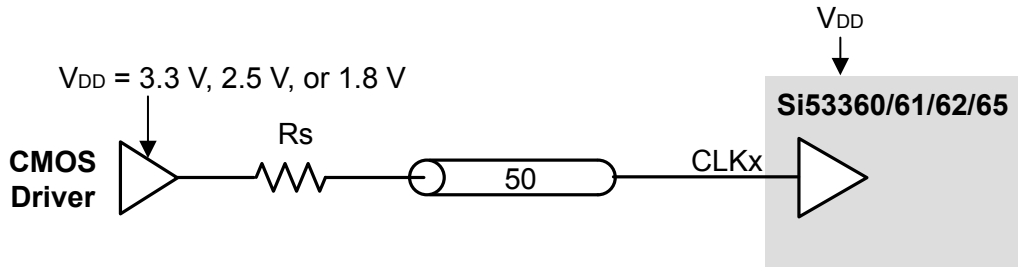
The Si53360/61/62/65 are a family of low-jitter, low skew, fixed format (LVMCOS) buffers. These devices are available in multiple configurations customized for the end application (refer to 1. Ordering Guide for more details on configurations).

2.1 LVCMOS Input Termination

The table below summarizes the various ac- and dc-coupling options supported by the LVCMOS device, and the figure shows the recommended input clock termination.

Table 2.1. LVCMOS Input Clock Options

	LVCMOS	
	AC-Coupled	DC-Coupled
1.8 V	No	Yes
2.5/3.3 V	Yes	Yes



Note: Value for Rs should be chosen so that the total source impedance matches the characteristic impedance of the PCB trace.

Figure 2.1. Recommended Input Clock Termination

2.2 Input Mux

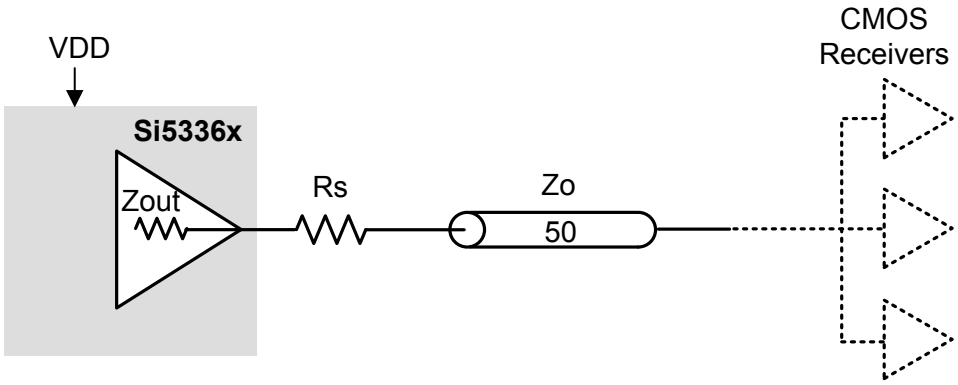
The Si53360-61/62 provide two clock inputs for applications that need to select between one of two clock sources. The CLK_SEL pin selects the active clock input. The following table summarizes the input and output clock based on the input mux settings.

Table 2.2. Input Mux Logic

CLK_SEL	CLK0	CLK1	Q
L	L	X	L
L	H	X	H
H	X	L	L
H	X	H	H

2.3 Output Clock Termination Options

The recommended output clock termination options are shown below. Unused outputs should be left unconnected.



Note:
Rs = 33 ohm for 3.3 V and 2.5 V operation.
Rs = 0 ohm for 1.8 V operation.

Figure 2.2. LVCMOS Output Termination

2.4 AC Timing Waveforms

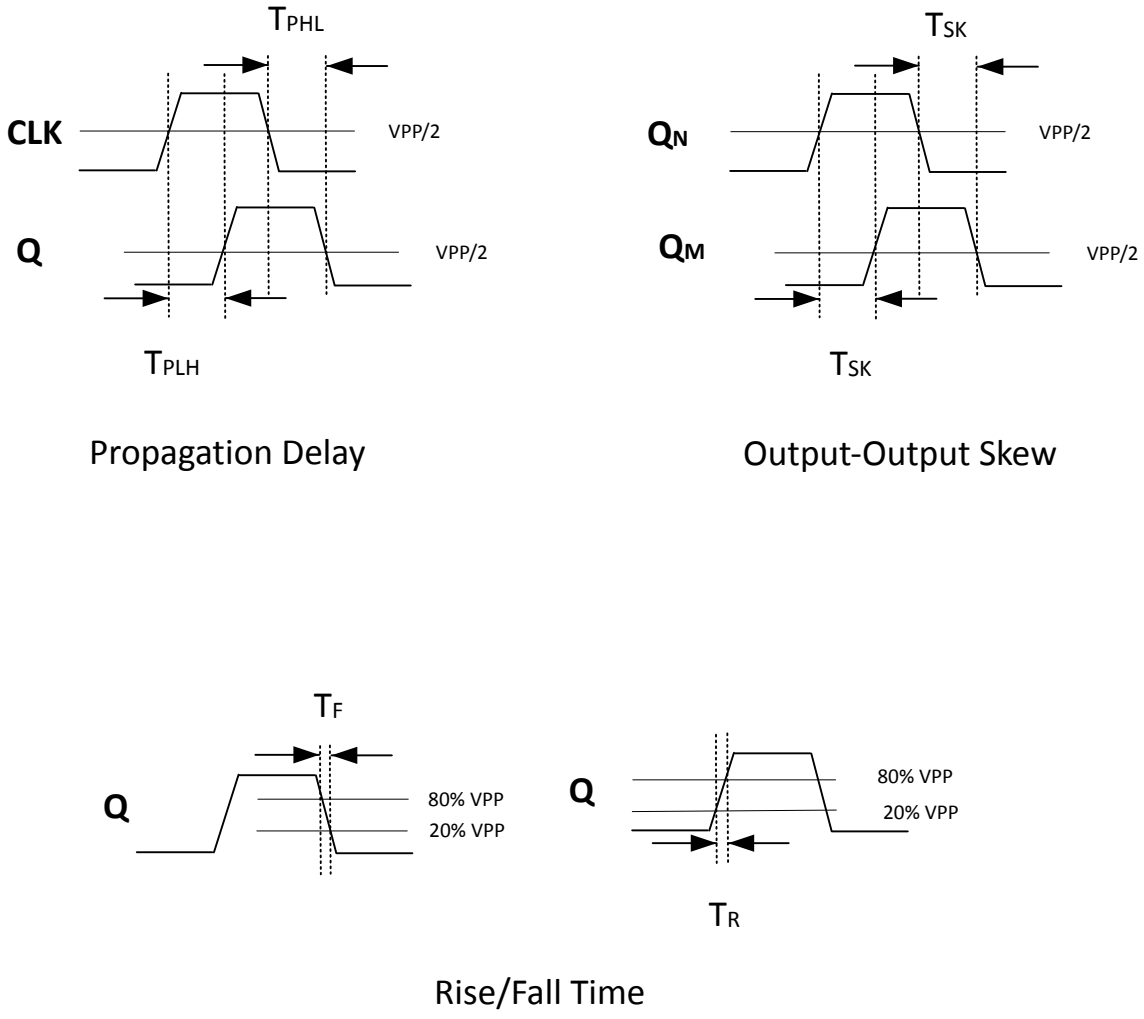


Figure 2.3. AC Timing Waveforms

2.5 Power Supply Noise Rejection

The device supports on-chip supply voltage regulation to reject power supply noise and simplify low-jitter operation in real-world environments. This feature enables robust operation alongside FPGAs, ASICs and SoCs and may reduce board-level filtering requirements. See "AN491: Power Supply Rejection for Low-Jitter Clocks" for more information.

2.6 Typical Phase Noise Performance: Single-Ended Input Clock

Each of the phase noise plots superimposes Source Jitter and Total Jitter on the same diagram.

- Source Jitter - Reference clock phase noise (measured Single-ended to PNA).
- Total Jitter - Combined source and clock buffer phase noise measured as a single-ended output to the phase noise analyzer and integrated from 12 kHz to 20 MHz. For more information, see 3. Electrical Specifications.

Note: To calculate the total RMS phase jitter when adding a buffer to your clock tree, use the root-sum-square (RSS).

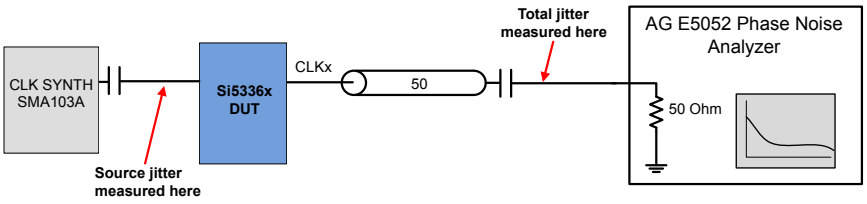
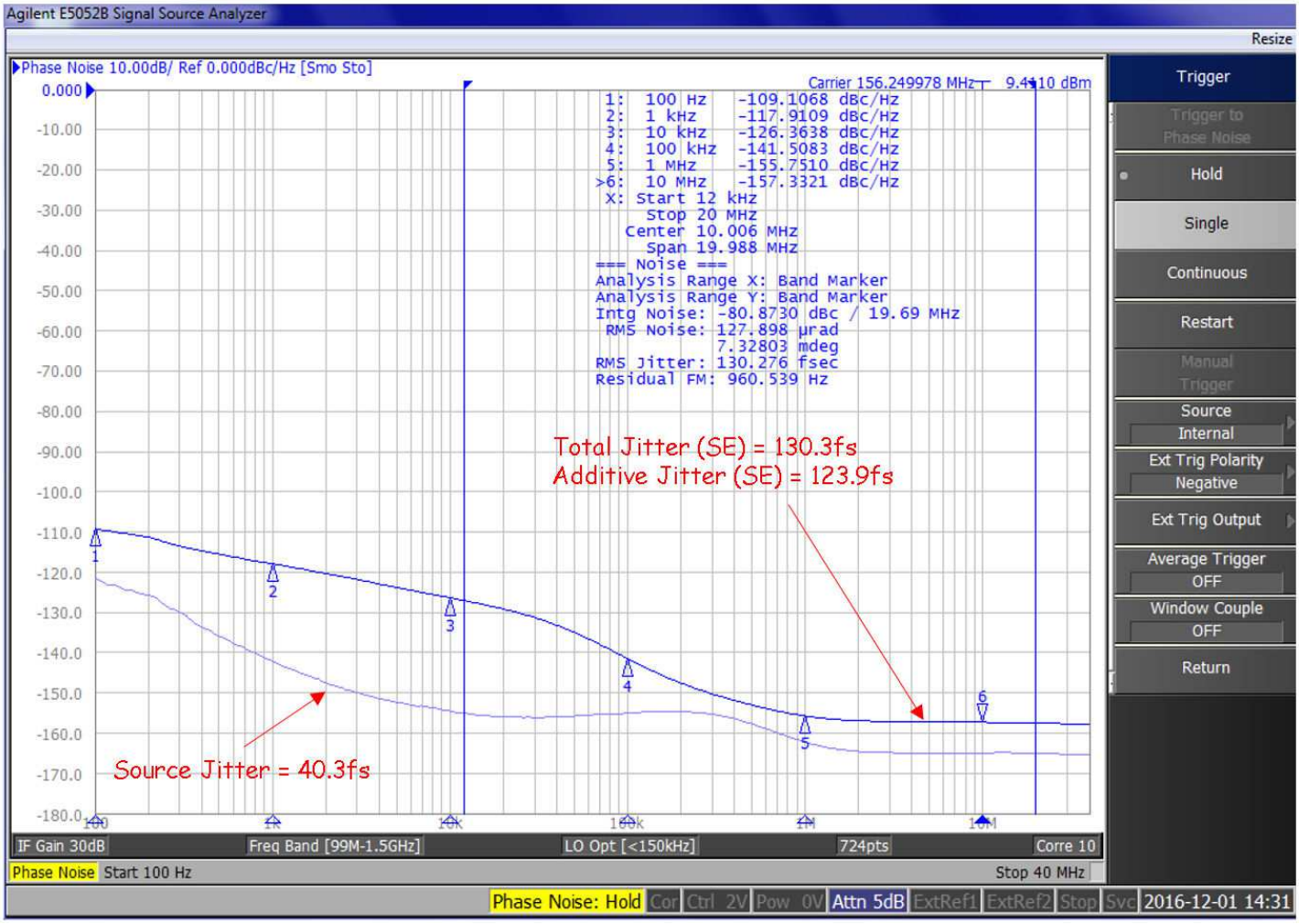


Figure 2.4. Single-ended Measurement Method

The following figure shows three phase noise plots superimposed on the same diagram.



Frequency (MHz)	Single-Ended Input Slew Rate (V/ns)	Source Jitter (fs)	Total Jitter (SE) (fs)	Additive Jitter (SE) (fs)
156.25	1.0	40.3	130.28	123.89

Figure 2.5. Total Jitter Single-Ended Input (156.25 MHz)

2.7 Input Mux Noise Isolation

The input clock mux is designed to minimize crosstalk between the CLK0 and CLK1. This improves phase jitter performance when clocks are present at both the CLK0 and CLK1 inputs. The following figure shows a measurement of the input mux's noise isolation.

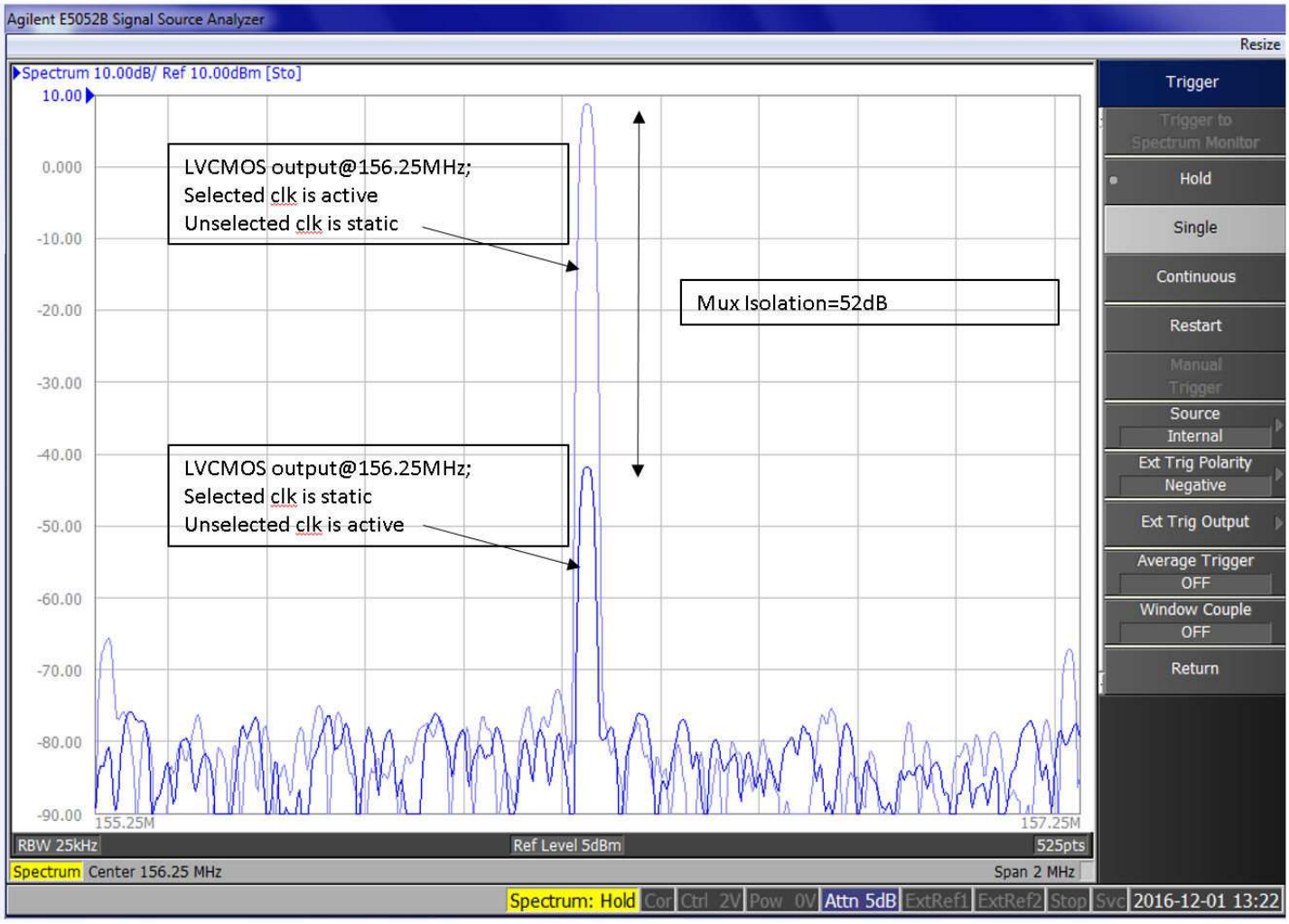


Figure 2.6. Input Mux Noise Isolation (Single-ended Input Clock, 16QFN Package)

3. Electrical Specifications

Table 3.1. Recommended Operating Conditions

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Ambient Operating Temperature	T_A		–40	—	85	°C
Supply Voltage Range	V_{DD}	LVCMOS	1.71	1.8	1.89	V
			2.38	2.5	2.63	V
			2.97	3.3	3.63	V

Table 3.2. Input Clock Specifications

V_{DD} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
LVCMOS Input High Voltage	V_{IH}		V_{DD} x 0.7	—	—	V
LVCMOS Input Low Voltage	V_{IL}		—	—	V_{DD} x 0.3	V
Input Capacitance	C_{IN}	CLK0 and CLK1 pins with respect to GND	—	5	—	pF

Table 3.3. DC Common Characteristics (CLK_SEL, OEx)

V_{DD} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Core Supply Current	I_{DD}1	V_{DD} = 3.3 V, Si53360/65	—	150	—	mA
		V_{DD} = 3.3 V, Si53361/62	—	35	—	mA
Output Supply Current (per clock output, Si53361/62 only)	I_{DDO}1	V_{DDOX} = 1.8 V	—	7	—	mA
		V_{DDOX} = 2.5 V	—	10	—	mA
		V_{DDOX} = 3.3 V	—	13	—	mA
Input High Voltage	V_{IH}		V_{DD} x 0.8	—	—	V
Input Low Voltage	V_{IL}		—	—	V_{DD} x 0.2	V
Internal Pull-up Resistor	R_{UP}	OE_X	—	25	—	kΩ
Internal Pull-down Resistor	R_{DN}	CLK_SEL	—	25	—	kΩ

Note:
1. Frequency = 200 MHz, C_{load} = 0 pF

Table 3.4. Output Characteristics (LVCMOS)

V_{DD} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Voltage High	V_{OH}	I_{OH} = –12 mA, V_{DD} = 3.3 V I_{OH} = –9 mA, V_{DD} = 2.5 V I_{OH} = –6 mA, V_{DD} = 1.8 V	V_{DD} x 0.8	—	—	V
Output Voltage Low	V_{OL}	I_{OL} = 12 mA, V_{DD} = 3.3 V I_{OL} = 9 mA, V_{DD} = 2.5 V I_{OL} = 6 mA, V_{DD} = 1.8 V	—	—	V_{DD} x 0.2	V

Table 3.5. AC Characteristics

V_{DD} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Frequency	F	LVCMOS	dc	—	200	MHz
Duty Cycle (50% input duty cycle)	DC	200 MHz, 2pF load TR/TF<10% of period	40	50	60	%
Minimum Input Clock Slew Rate	SR	Required to meet prop delay and additive jitter specifications (20–80%)	0.75	—	—	V/ns
Output Rise/Fall Time	T_R/T_F	200 MHz, 20/80%, 2 pF load	—	—	850	ps
Minimum Input Pulse Width	T_W		2	—	—	ns
Propagation Delay	T_{PLH}, T_{PHL}	Low-to-high, high-to-low Single-ended, C_L = 2 pF	1.5	3.0	4.5	ns
Output Enable Time	T_{EN}	F = 1 MHz	—	10	—	ns
		F = 100 MHz	—	10	—	ns
Output Disable Time	T_{DIS}	F = 1 MHz	—	20	—	ns
		F = 100 MHz	—	20	—	ns
Part-to-Part Skew	T_{SKPP}	C_L = 2 pF	0	—	300	ps
Output-to-Output Skew	T_{SK}	C_L= 2 pF	—	40	125	ps

Table 3.6. Additive Jitter

V_{DD}	Input[1]				Output	Additive Jitter (fs rms, 12 kHz to 20 MHz)	
	Freq (MHz)	Clock Format	Amplitude V_{IN} (Single-Ended, Peak-to-Peak)	Differential 20% to 80% Slew Rate (V/ns)	Clock Format	Typ	Max
3.3	200	SINGLE-ENDED	0.15	0.637	LVCMOS	130	180
3.3	156.25	SINGLE-ENDED	0.5	0.458	LVCMOS	125	220
2.5	200	SINGLE-ENDED	0.15	0.637	LVCMOS	115	250
2.5	156.25	SINGLE-ENDED	0.5	0.458	LVCMOS	125	240

Note:

1. For best additive jitter results, use the fastest slew rate possible. See "AN766: Understanding and Optimizing Clock Buffer's Additive Jitter Performance" for more information.

Table 3.7. Thermal Conditions

Parameter	Symbol	Test Condition	Value	Unit
16- TSSOP Thermal Resistance, Junction to Ambient	θ_{JA}	Still air	124.4	°C/W
16-QFN Thermal Resistance, Junction to Ambient	θ_{JA}	Still air	57.6	°C/W
16- QFN Thermal Resistance, Junction to Case	θ_{JC}	Still air	41.5	°C/W
24-QFN Thermal Resistance, Junction to Ambient	θ_{JA}	Still air	37	°C/W
24- QFN Thermal Resistance, Junction to Case	θ_{JC}	Still air	25	°C/W

Table 3.8. Absolute Maximum Ratings

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Storage Temperature	T_S		–55	—	150	°C
Supply Voltage	V_{DD}		–0.5	—	3.8	V
Input Voltage	V_{IN}		–0.5	—	V_{DD} + 0.3	V
Output Voltage	V_{OUT}		—	—	V_{DD} + 0.3	V
ESD Sensitivity	HBM	HBM, 100 pF, 1.5 kΩ	—	—	2000	V
	CDM		—	—	500	V
Peak Soldering Reflow Temperature	T_{PEAK}	Pb-Free; Solder reflow profile per JEDEC J-STD-020	—	—	260	°C
Maximum Junction Temperature	T_J		—	—	125	°C

Note:

1. Stresses beyond those listed in this table may cause permanent damage to the device. Functional operation specification compliance is not implied at these conditions. Exposure to maximum rating conditions for extended periods may affect device reliability.

4. Detailed Block Diagrams

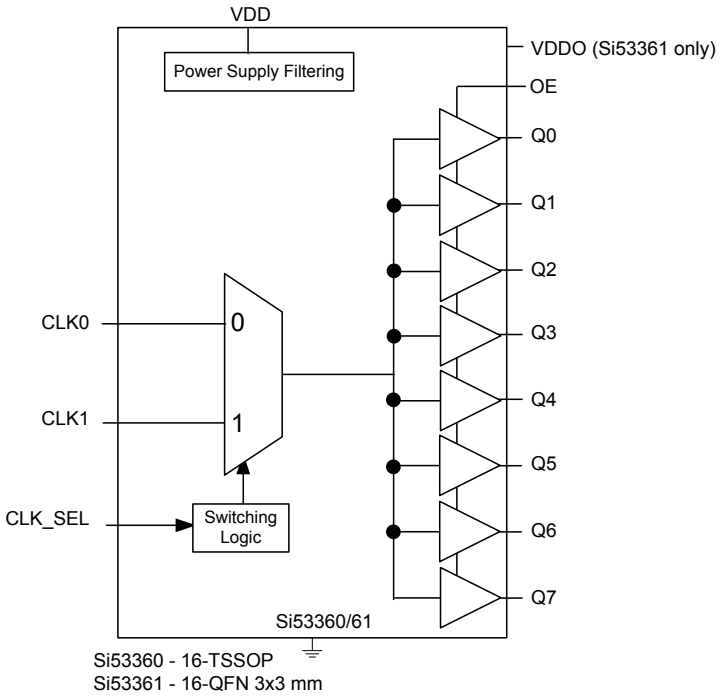


Figure 4.1. Si53360 and Si53361 Block Diagram

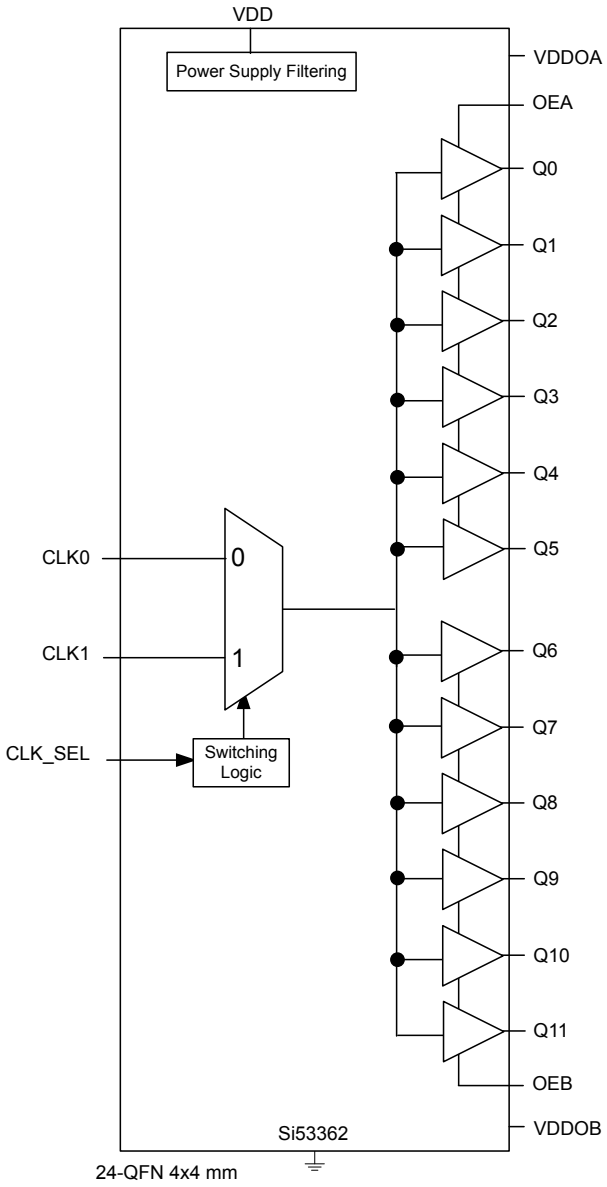


Figure 4.2. Si53362 Block Diagram

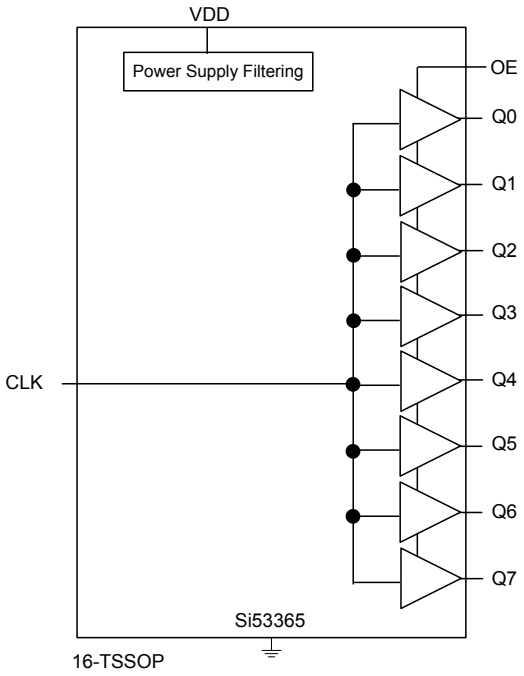


Figure 4.3. Si53365 Block Diagram

5. Si5336x Pin Descriptions

5.1 Si53360 Pin Descriptions

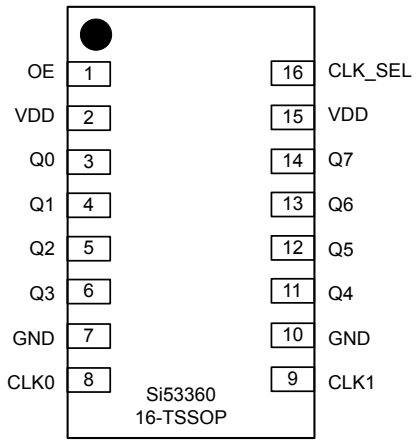


Figure 5.1. Si53360 Pin Descriptions

Table 5.1. Si53360 16-TSSOP Pin Descriptions

Pin	Name	Type[1]	Description
1	OE	I	Output enable. When OE= high, the clock outputs are enabled. When OE= low, the clock outputs are tri-stated. OE features an internal pull-up resistor, and may be left unconnected.
2	VDD	P	Core voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDD pin as possible.
3	Q0	O	Output Clock 0.
4	Q1	O	Output Clock 1.
5	Q2	O	Output Clock 2.
6	Q3	O	Output Clock 3.
7	GND	GND	Ground.
8	CLK0	I	Input Clock 0.
9	CLK1	I	Input Clock 1.
10	GND	GND	Ground.
11	Q4	O	Output Clock 4.
12	Q5	O	Output Clock 5.
13	Q6	O	Output Clock 6.
14	Q7	O	Output Clock 7.
15	VDD	P	Core voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDD pin as possible.
16	CLK_SEL	I	Mux input select pin (LVCMOS). When CLK_SEL is high, CLK1 is selected. When CLK_SEL is low, CLK0 is selected. CLK_SEL contains an internal pull-down resistor.

Pin	Name	Type[1]	Description

Note:

1. I = Input; O = Output; P = Power; GND = Ground.

5.2 Si53361 Pin Descriptions

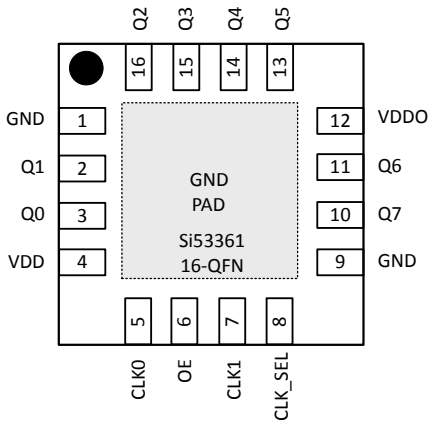


Figure 5.2. Si53361 Pin Descriptions

Table 5.2. Si53361 16-QFN Pin Descriptions

Pin	Name	Type[1]	Description
1	GND	GND	Ground.
2	Q1	O	Output Clock 1.
3	Q0	O	Output Clock 0.
4	VDD	P	Core voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDD pin as possible.
5	CLK0	I	Input Clock 0.
6	OE	I	Output enable. When OE= high, the clock outputs are enabled. When OE= low, the clock outputs are tri-stated. OE features an internal pull-up resistor, and may be left unconnected.
7	CLK1	I	Input Clock 1.
8	CLK_SEL	I	Mux input select pin (LVCMOS). When CLK_SEL is high, CLK1 is selected. When CLK_SEL is low, CLK0 is selected. CLK_SEL contains an internal pull-down resistor.
9	GND	GND	Ground.
10	Q7	O	Output Clock 7.
11	Q6	O	Output Clock 6.
12	VDDO	P	Output voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDDO pin as possible.
13	Q5	O	Output Clock 5.
14	Q4	O	Output Clock 4.
15	Q3	O	Output Clock 3.
16	Q2	O	Output Clock 2.
GND Pad	Exposed Ground Pad	GND	Power supply ground and thermal relief. The exposed ground pad is thermally connected to the die to improve the heat transfer out of the package. The ground pad must be connected to GND to ensure device specifications are met.

Pin	Name	Type[1]	Description

Note:

1. I = Input; O = Output; P = Power; GND = Ground.

5.3 Si53362 Pin Descriptions

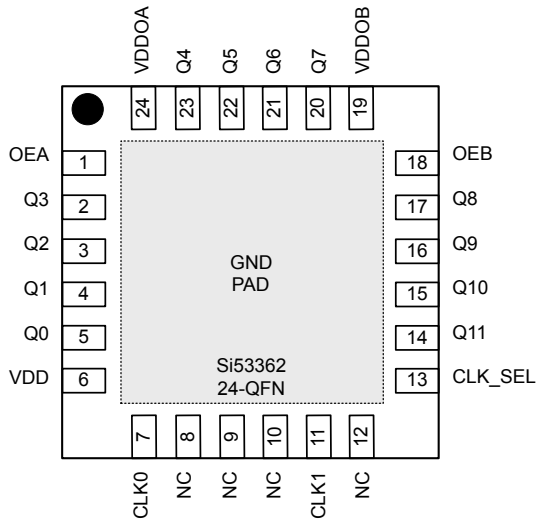


Figure 5.3. Si53362 Pin Descriptions

Table 5.3. Si53362 24-QFN Pin Descriptions

Pin	Name	Type[1]	Description
1	OEA	I	Output Enable for Bank A (Q0-Q5). When OEA = HIGH, outputs Q0-Q5 are enabled. This pin contains an internal pull-up resistor, and leaving the pin disconnected enables the outputs. When OEA = LOW, Q0-Q5 are tri-stated.
2	Q3	O	Output Clock 3.
3	Q2	O	Output Clock 2.
4	Q1	O	Output Clock 1.
5	Q0	O	Output Clock 0.
6	VDD	P	Core voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDD pin as possible.
7	CLK0	I	Input Clock 0.
8	NC	—	No connect. Leave this pin unconnected.
9	NC	—	No connect. Leave this pin unconnected.
10	NC	—	No connect. Leave this pin unconnected.
11	CLK1	I	Input Clock 1.
12	NC	—	No connect. Leave this pin unconnected.
13	CLK_SEL	I	Mux input select pin (LVCMOS). When CLK_SEL is high, CLK1 is selected. When CLK_SEL is low, CLK0 is selected. CLK_SEL contains an internal pull-down resistor.
14	Q11	O	Output Clock 11.
15	Q10	O	Output Clock 10.
16	Q9	O	Output Clock 9.

Pin	Name	Type[1]	Description
17	Q8	O	Output Clock 8.
18	OEB	I	Output Enable for Bank B (Q6-Q11). When OEB = HIGH, outputs Q6-Q11 are enabled. This pin contains an internal pull-up resistor, and leaving the pin disconnected enables the outputs. When OEB = LOW, Q6-Q11 are tri-stated.
19	VDDOB	P	Output voltage supply—Bank B (Outputs: Q6 to Q11). Bypass with 1.0 µF capacitor and place as close to the VDDOB pin as possible.
20	Q7	O	Output Clock 7.
21	Q6	O	Output Clock 6.
22	Q5	O	Output Clock 5.
23	Q4	O	Output Clock 4.
24	VDDOA	P	Output voltage supply—Bank A (Outputs: Q0 to Q5). Bypass with 1.0 µF capacitor and place as close to the VDDOA pin as possible.
GND Pad	Exposed Ground Pad	GND	Ground Pad - Power supply ground and thermal relief. The exposed ground pad is thermally connected to the die to improve the heat transfer out of the package. The ground pad must be connected to GND to ensure device specifications are met.

Note:

1. I = Input; O = Output; P = Power; GND = Ground.

5.4 Si53365 Pin Descriptions

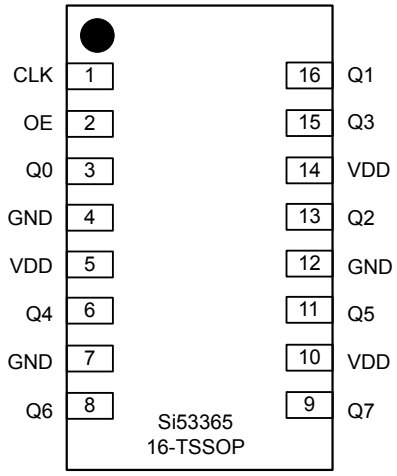


Figure 5.4. Si53365 Pin Descriptions

Table 5.4. Si53365 16-TSSOP Pin Descriptions

Pin	Name	Type[1]	Description
1	CLK	I	Input Clock.
2	OE	I	Output enable. When OE= high, the clock outputs are enabled. When OE= low, the clock outputs are tri-stated. OE features an internal pull-up resistor, and may be left unconnected.
3	Q0	O	Output Clock 0.
4	GND	GND	Ground.
5	VDD	P	Core voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDD pin as possible.
6	Q4	O	Output Clock 4.
7	GND	GND	Ground.
8	Q6	O	Output Clock 6.
9	Q7	O	Output Clock 7.
10	VDD	P	Core voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDD pin as possible.
11	Q5	O	Output Clock 5.
12	GND	GND	Ground.
13	Q2	O	Output Clock 2.
14	VDD	P	Core voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDD pin as possible.
15	Q3	O	Output Clock 3.
16	Q1	O	Output Clock 1.

Pin	Name	Type[1]	Description

Note:

1. I = Input; O = Output; P = Power; GND = Ground.

6. Package Outline

6.1 16-Pin TSSOP Package

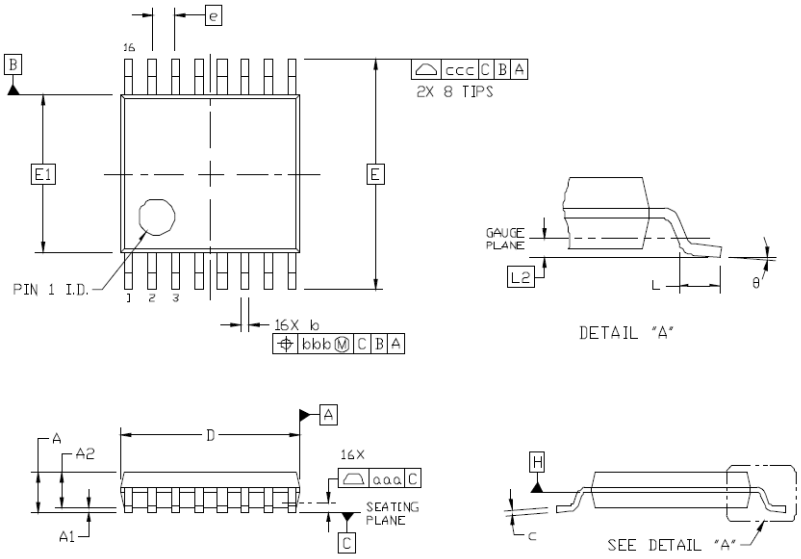


Figure 6.1. 16-Pin TSSOP Package

Table 6.1. 16-Pin TSSOP Package Dimensions

Dimension	Min	Nom	Max
A	—	—	1.20
A1	0.05	—	0.15
A2	0.80	1.00	1.05
b	0.19	—	0.30
c	0.09	—	0.20
D	4.90	5.00	5.10
E		6.40 BSC	
E1	4.30	4.40	4.50
e		0.65 BSC	
L	0.45	0.60	0.75
L2		0.25 BSC	
Θ	0°	—	8°
aaa		0.10	
bbb		0.10	
ccc		0.20	

Dimension	Min	Nom	Max

Note:

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to the JEDEC Solid State Outline MO-220.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020C specification for Small Body Components.

6.2 16-Pin QFN Package

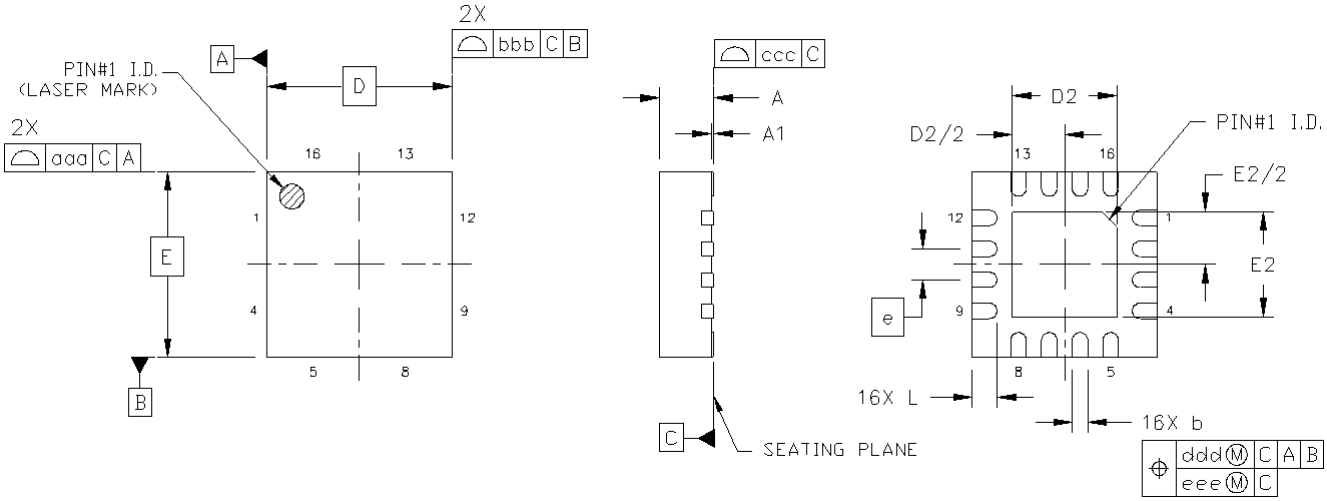


Figure 6.2. 16-Pin QFN Package

Table 6.2. 16-QFN Package Dimensions

Dimension	Min	Nom	Max
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
b	0.18	0.25	0.30
D		3.00 BSC.	
D2	1.65	1.70	1.75
e		0.50 BSC.	
E		3.00 BSC.	
E2	1.65	1.70	1.75
L	0.30	0.40	0.50
aaa	—	—	0.10
bbb	—	—	0.10
ccc	—	—	0.08
ddd	—	—	0.10
eee	—	—	0.05

Note:
1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.

6.3 24-Pin QFN Package

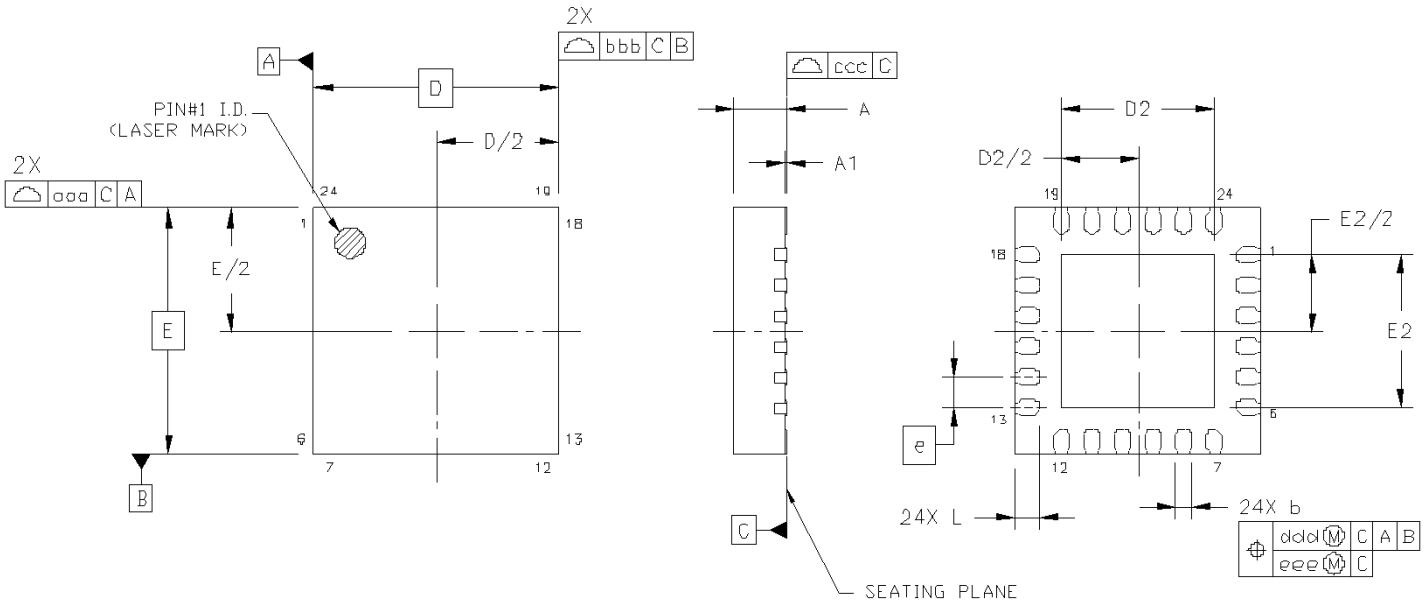


Figure 6.3. 24-Pin QFN Package

Table 6.3. 24-QFN Package Dimensions

Dimension	Min	Nom	Max
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
b	0.18	0.25	0.30
D		4.00 BSC.	
D2	2.35	2.50	2.65
e		0.50 BSC.	
E		4.00 BSC.	
E2	2.35	2.50	2.65
L	0.30	0.40	0.50
aaa		0.10	
bbb		0.10	
ccc		0.08	
ddd		0.10	
eee		0.05	

Note:

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to JEDEC outline MO-220, variation VGGD-8.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020C specification for Small Body Components.