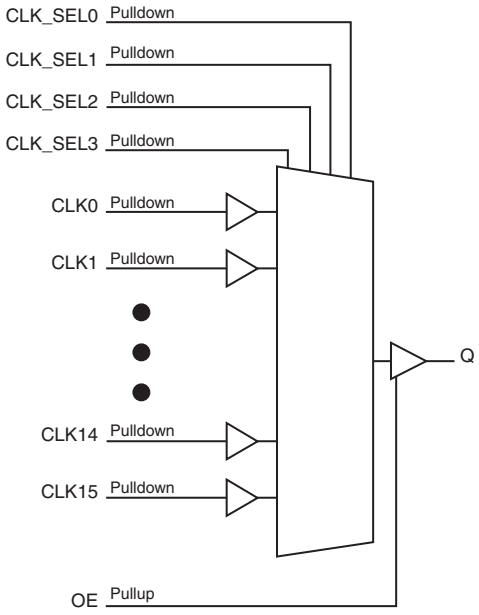
General Description

The ICS850S1061I is a low skew16:1 Single-ended Clock Multiplexer and is a member of the HiPerClockS™ family of High Performance Clock Solutions from IDT. The ICS850S1061I has 16 selectable single-ended clock inputs and 1 single-ended clock output. The device operates up to 250MHz and is packaged in a 24 TSSOP package.

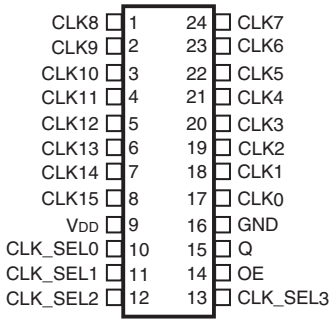
Features

- 16:1 single-ended multiplexer
- Nominal output impedance: 20Ω (V_{DD} = 3.3V)
- Maximum output frequency: 250MHz
- Propagation delay: 2.7ns (maximum)
- Full 3.3V or 2.5V supply modes
- -40°C to 85°C ambient operating temperature
- Available in lead-free (RoHS 6) packages

Block Diagram



Pin Assignment



ICS850S1601I

24-Lead TSSOP
4.4mm x 7.8mm x 0.925mm
package body
G Package
Top View

Table 1. Pin Descriptions

Number	Name	Type		Description
1	CLK8	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
2	CLK9	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
3	CLK10	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
4	CLK11	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
5	CLK12	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
6	CLK13	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
7	CLK14	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
8	CLK15	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
9	V_{DD}	Power		Power supply pin.
10, 11. 12, 13	CLK_SEL0, CLK_SEL1, CLK_SEL2, CLK_SEL3	Input	Pulldown	Clock select inputs. See Table 3. LVCMOS / LVTTL interface levels.
14	OE	Input	Pullup	Output enable pin for Q output. LVCMOS/LVTTL interface levels.
15	Q	Output		Single-ended clock output. LVCMOS/LVTTL interface levels.
16	GND	Power		Power supply ground.
17	CLK0	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
18	CLK1	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
19	CLK2	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
20	CLK3	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
21	CLK4	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
22	CLK5	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
23	CLK6	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
24	CLK7	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.

NOTE: *Pullup and Pulldown* refer to internal input resistors. See Table 2, *Pin Characteristics,* for typical values.

Table 2. Pin Characteristics

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
C_{IN}	Input Capacitance			2		pF
C_{PD}	Power Dissipation Capacitance	V_{DD} = 3.465V		10		pF
		V_{DD} = 2.625V		8		pF
R_{PULLUP}	Input Pullup Resistor			51		kΩ
$R_{PULLDOWN}$	Input Pulldown Resistor			51		kΩ
R_{OUT}	Output Impedance	V_{DD} = 3.3V±5%		20		Ω
		V_{DD} = 2.5V±5%		25		Ω

Function Tables

Table 3. Clock Input Function Table

Inputs				
CLK_SEL3	CLK_SEL2	CLK_SEL1	CLK_SEL0	Input Selected to Q
0	0	0	0	CLK0
0	0	0	1	CLK1
0	0	1	0	CLK2
0	0	1	1	CLK3
0	1	0	0	CLK4
0	1	0	1	CLK5
0	1	1	0	CLK6
0	1	1	1	CLK7
1	0	0	0	CLK8
1	0	0	1	CLK9
1	0	1	0	CLK10
1	0	1	1	CLK11
1	1	0	0	CLK12
1	1	0	1	CLK13
1	1	1	0	CLK14
1	1	1	1	CLK15

Absolute Maximum Ratings

NOTE: Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in the *DC Characteristics or AC Characteristics* is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

Item	Rating
Supply Voltage, V_{DD}	4.6V
Inputs, V_I	-0.5V to V_{DD} + 0.5V
Outputs, V_O	-0.5V to V_{DD} + 0.5V
Package Thermal Impedance, θ_{JA}	82.8°C/W (0 mps)
Storage Temperature, T_{STG}	-65°C to 150°C

DC Electrical Characteristics

Table 4A. Power Supply DC Characteristics, V_{DD} = 3.3V ± 5%, T_A = -40°C to 85°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Positive Supply Voltage		3.135	3.3	3.465	V
I_{DD}	Power Supply Current	Output Unterminated			49	mA

Table 4B. Power Supply DC Characteristics, V_{DD} = 2.5V ± 5%, T_A = -40°C to 85°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Positive Supply Voltage		2.375	2.5	2.625	V
I_{DD}	Power Supply Current	Output Unterminated			41	mA

Table 4C. LVCMOS/LVTTL DC Characteristics, V_{DD} = 3.3V ± 5% or 2.5V ± 5%, T_A = -40°C to 85°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage		V_{DD} = 3.465V	2		V_{DD} + 0.3	V
			V_{DD} = 2.625V	1.7		V_{DD} + 0.3	V
V_{IL}	Input Low Voltage		V_{DD} = 3.465V	-0.3		0.8	V
			V_{DD} = 2.625V	-0.3		0.7	V
I_{IH}	Input High Current	CLK[0:15], CLK_SEL[0:3]	V_{DD} = V_{IN} = 3.465V or 2.625V			150	µA
		OE	V_{DD} = V_{IN} = 3.465V or 2.625V			10	µA
I_{IL}	Input Low Current	CLK[0:15], CLK_SEL[0:3]	V_{DD} = 3.465V or 2.625V, V_{IN} = 0V	-10			µA
		OE	V_{DD} = 3.465V or 2.625V, V_{IN} = 0V	-150			µA
V_{OH}	Output High Voltage; NOTE 1		V_{DD} = 3.3V ± 5%, I_{OH} = -12mA	2.6			V
			V_{DD} = 2.5V ± 5%, I_{OH} = -12mA	1.8			V
V_{OL}	Output Low Voltage; NOTE 1		V_{DD} = 3.3V ± 5% or 2.5V ± 5%, I_{OL} = 12mA			0.5	V

NOTE 1: Output terminated with 50Ω to V_{DD}/2. See Parameter Measurement Information section. *Load Test Circuit diagrams.*

AC Electrical Characteristics

Table 5A. AC Characteristics, V_{DD} = 3.3V ± 5%, T_A = -40°C to 85°C

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Output Frequency				250	MHz
tp_{LH}	Propagation Delay, Low-to-High; NOTE 1		1.4		2.7	ns
*t*jit	Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter Section	155.52MHz, Integration Range: 12kHz – 20MHz		0.35		ps
*t*sk(i)	Input Skew				175	ps
*t*sk(pp)	Part-to-Part Skew; NOTE 2, 3				600	ps
t_R / t_F	Output Rise/Fall Time	20% to 80%	100		500	ps
odc	Output Duty Cycle; NOTE 4	f ≤ 200MHz	46		54	%
		f = 250MHz	40		60	%
$MUX_{ISOLATION}$	MUX Isolation	155.52MHz		43		dB

NOTE 1: Measured from V_{DD}/2 of the input to V_{DD}/2 of the output.
NOTE 2: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.
NOTE 3: This parameter is defined according with JEDEC Standard 65.
NOTE 4: Input duty cycle must be 50%.

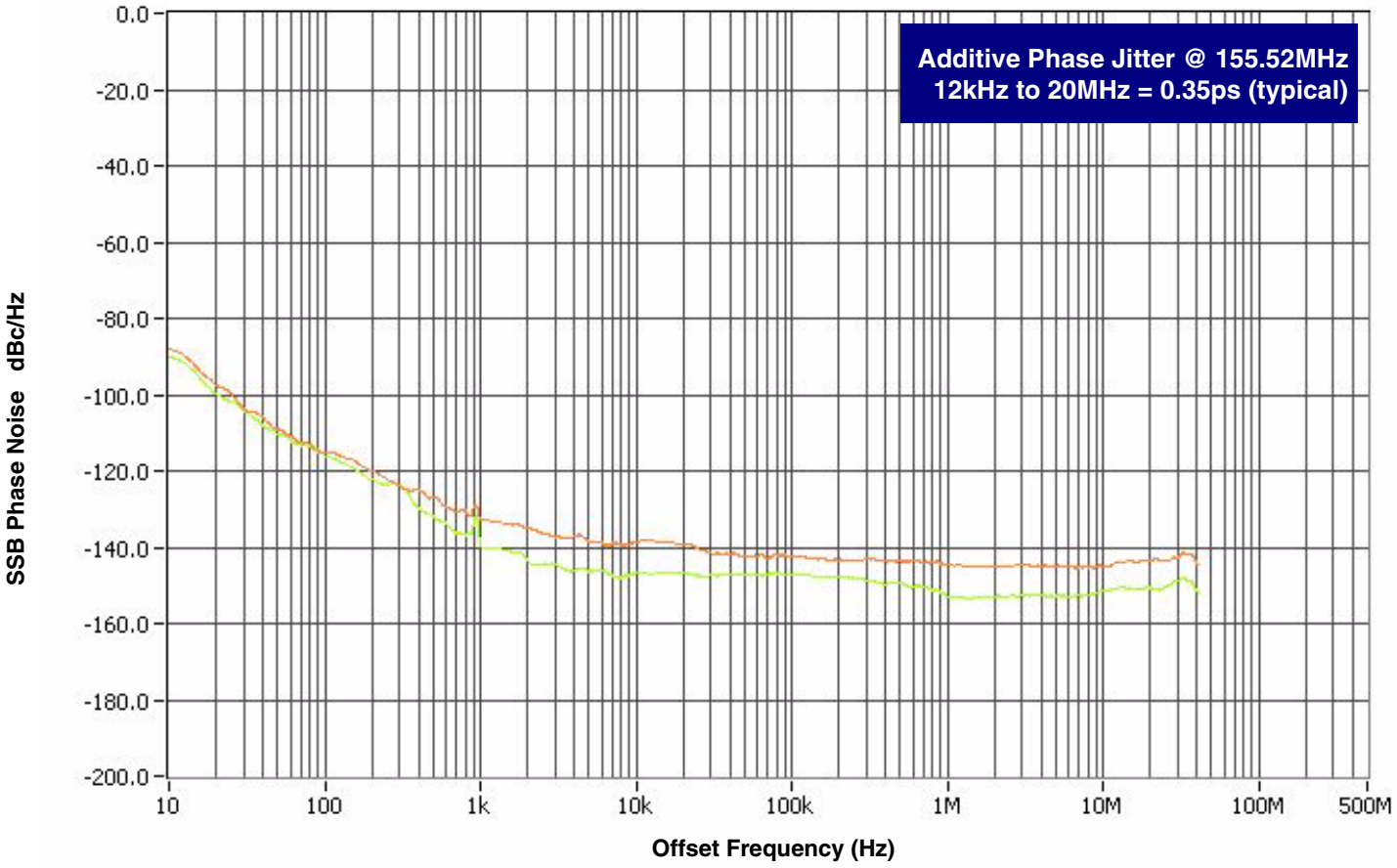
Table 5B. AC Characteristics, V_{DD} = 2.5V ± 5%, T_A = -40°C to 85°C

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Output Frequency				250	MHz
tp_{LH}	Propagation Delay, Low-to-High; NOTE 1		1.5		2.7	ns
*t*jit	Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter Section	155.52MHz, Integration Range: 12kHz – 20MHz		0.32		ps
*t*sk(i)	Input Skew				195	ps
*t*sk(pp)	Part-to-Part Skew; NOTE 2, 3				600	ps
t_R / t_F	Output Rise/Fall Time	20% to 80%	80		600	ps
odc	Output Duty Cycle; NOTE 4	f ≤ 200MHz	46		54	%
		f = 250MHz	40		60	%
$MUX_{ISOLATION}$	MUX Isolation	155.52MHz		43		dB

NOTE 1: Measured from V_{DD}/2 of the input to V_{DD}/2 of the output.
NOTE 2: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.
NOTE 3: This parameter is defined according with JEDEC Standard 65.
NOTE 4: Input duty cycle must be 50%.

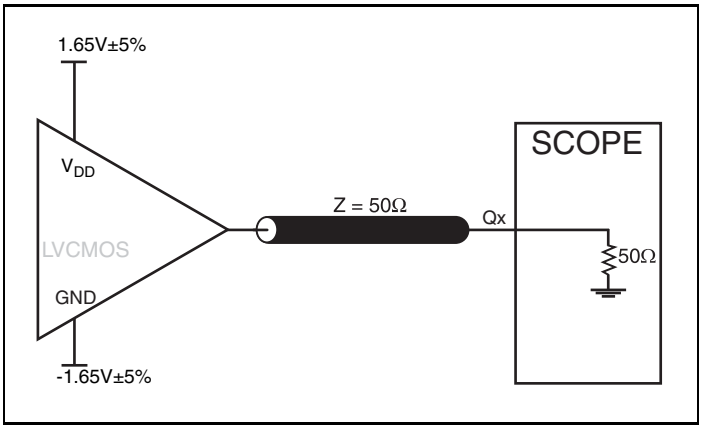
Additive Phase Jitter

The spectral purity in a band at a specific offset from the fundamental compared to the power of the fundamental is called the ***dBc Phase Noise.*** This value is normally expressed using a Phase noise plot and is most often the specified plot in many applications. Phase noise is defined as the ratio of the noise power present in a 1Hz band at a specified offset from the fundamental frequency to the power value of the fundamental. This ratio is expressed in decibels (dBm) or a ratio of the power in the 1Hz band to the power in the fundamental. When the required offset is specified, the phase noise is called a ***dBc*** value, which simply means dBm at a specified offset from the fundamental. By investigating jitter in the frequency domain, we get a better understanding of its effects on the desired application over the entire time record of the signal. It is mathematically possible to calculate an expected bit error rate given a phase noise plot.

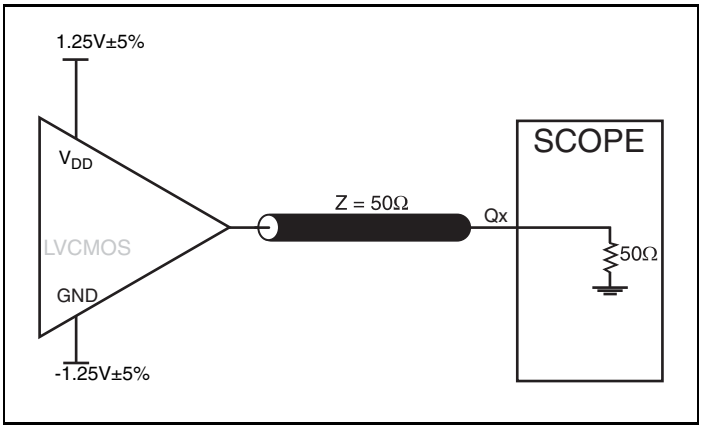


As with most timing specifications, phase noise measurements has issues relating to the limitations of the equipment. Often the noise floor of the equipment is higher than the noise floor of the device. This is illustrated above. The device meets the noise floor of what is shown, but can actually be lower. The phase noise is dependent on the input source and measurement equipment.

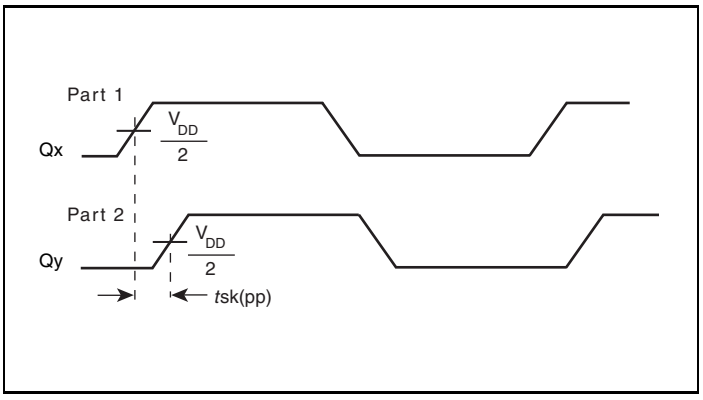
Parameter Measurement Information



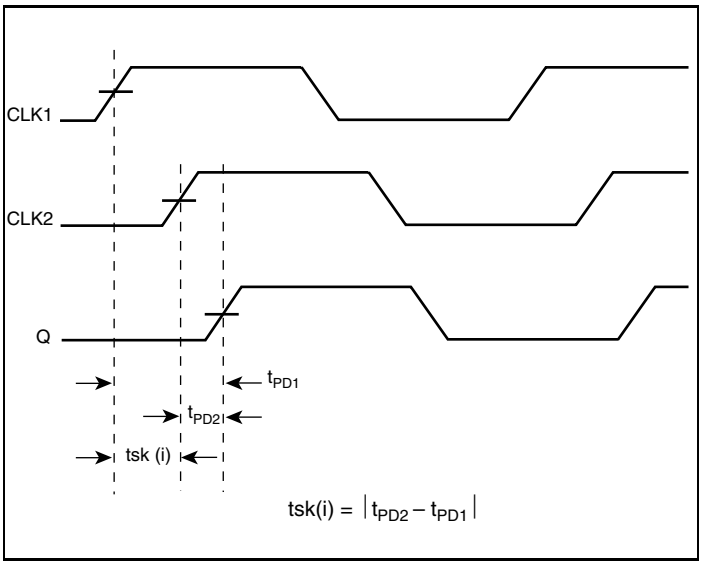
3.3V Output Load AC Test Circuit



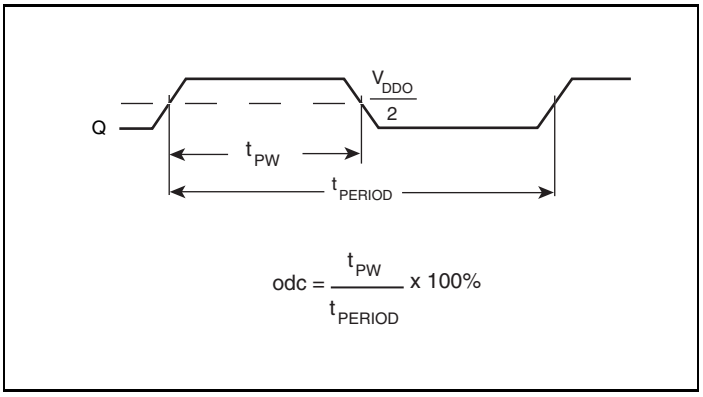
2.5V Output Load AC Test Circuit



Part-to-Part Skew

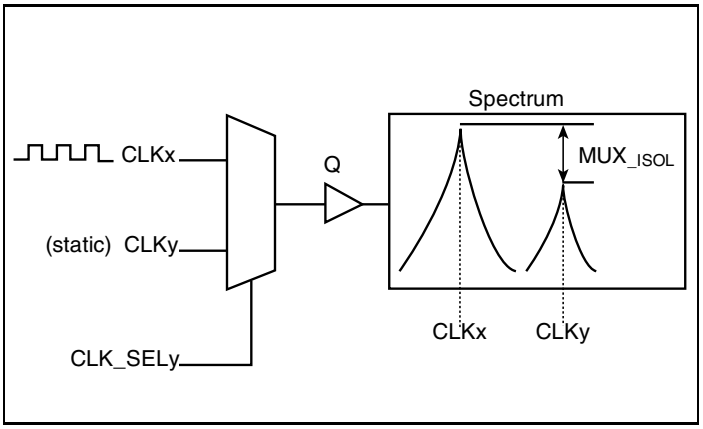


Input Skew

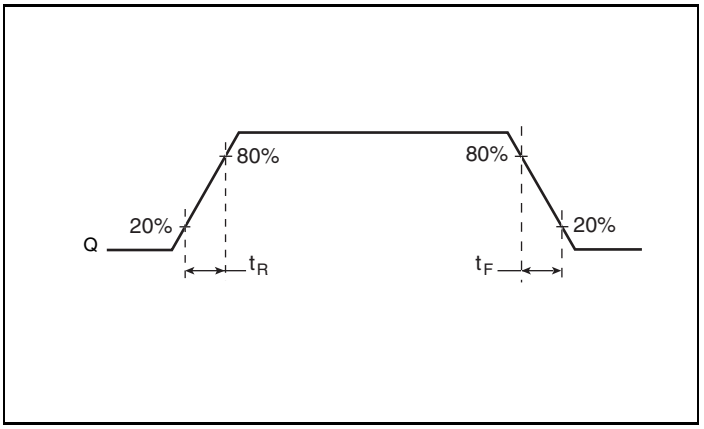


Output Duty Cycle/Pulse Width/Period

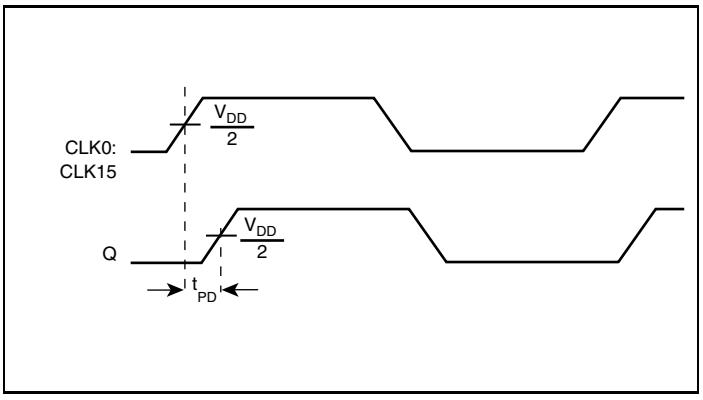
Parameter Measurement Information, continued



MUX Isolation



Output Rise/Fall Time



Propagation Delay

Application Information

Recommendations for Unused Input Pins

Inputs:

CLK Inputs

For applications not requiring the use of a clock input, it can be left floating. Though not required, but for additional protection, a 1kΩ resistor can be tied from the CLK input to ground.

LVCMOS Control Pins

All control pins have internal pull-ups or pull-downs; additional resistance is not required but can be added for additional protection. A 1kΩ resistor can be used.

Reliability Information

Table 6. θ_{JA} vs. Air Flow Table for a 24 Lead TSSOP

θ_{JA} vs. Air Flow			
Meters per Second	**0**	**1**	**2.5**
Multi-Layer PCB, JEDEC Standard Test Boards	82.8°C/W	78.5	76.3

Transistor Count

The transistor count for ICS859S1601I is: 649

Package Outline and Package Dimensions

Package Outline - G Suffix for 24 Lead TSSOP

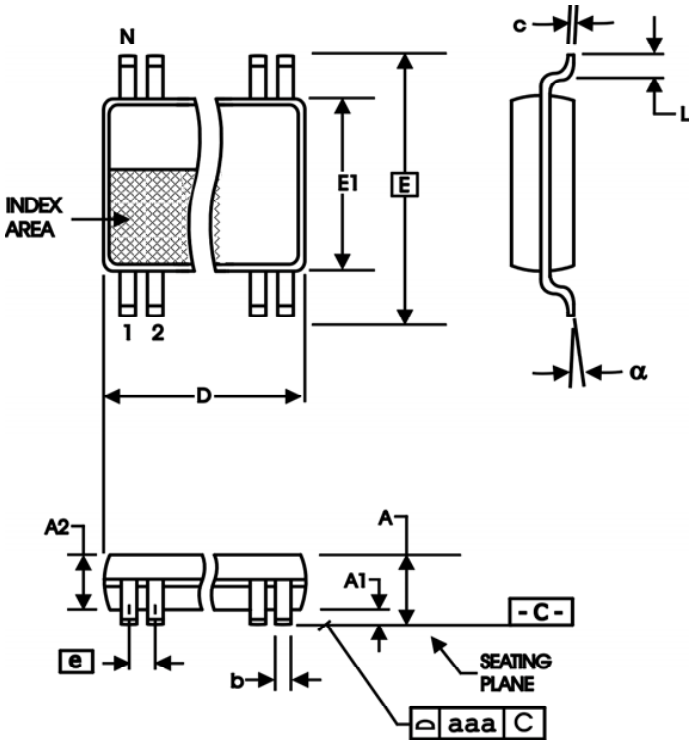


Table 7. Package Dimensions

All Dimensions in Millimeters		
Symbol	**Minimum**	**Maximum**
N	24	
A		1.20
A1	0.5	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	7.70	7.90
E	6.40 Basic	
E1	4.30	4.50
e	0.65 Basic	
L	0.45	0.75
α	0°	8°
aaa		0.10

Reference Document: JEDEC Publication 95, MO-153

Ordering Information

Table 9. Ordering Information

Part/Order Number	Marking	Package	Shipping Packaging	Temperature
850S1601BGILF	ICS50S1601BIL	“Lead-Free” 24 Lead TSSOP	Tube	-40°C to 85°C
850S1601BGILFT	ICS50S1601BIL	“Lead-Free” 24 Lead TSSOP	2500 Tape & Reel	-40°C to 85°C

NOTE: Parts that are ordered with an "LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

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