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**GENERAL DESCRIPTION**

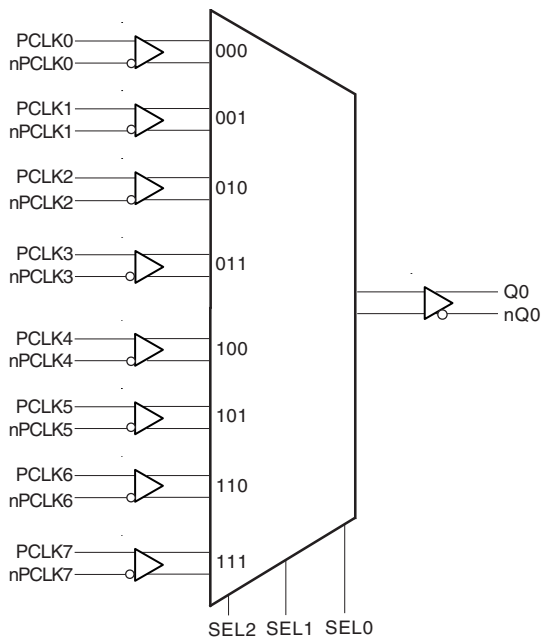


The ICS854058 is an 8:1 Differential-to-LVDS Clock Multiplexer which can operate up to 2.5GHz and is a member of the HiPerClockS™ family of High Performance Clock Solutions from ICS. The ICS854058 has 8 selectable differential clock inputs. The PCLK, nPCLK input pairs can accept LVPECL, LVDS, CML or SSTL levels. The fully differential architecture and low propagation delay make it ideal for use in clock distribution circuits. The select pins have internal pulldown resistors. The SEL2 pin is the most significant bit and the binary number applied to the select pins will select the same numbered data input (i.e., 000 selects PCLK0, nPCLK0).

**FEATURES**

- High speed 8:1 differential multiplexer
- 1 differential LVDS output
- 8 selectable differential PCLK, nPCLK inputs
- PCLKx, nPCLKx pairs can accept the following differential input levels: LVPECL, LVDS, CML, SSTL
- Maximum output frequency: 2.5GHz
- Translates any single ended input signal to LVDS levels with resistor bias on nPCLKx input
- Part-to-part skew: TBD
- Propagation delay: 595ps (typical)
- Supply voltage range: 3.135V to 3.465V
- -40°C to 85°C ambient operating temperature

**BLOCK DIAGRAM**



**PIN ASSIGNMENT**

PCLK0	1	24	PCLK7
nPCLK0	2	23	nPCLK7
PCLK1	3	22	PCLK6
nPCLK1	4	21	nPCLK6
V <sub>DD</sub>	5	20	V <sub>DD</sub>
SEL0	6	19	Q0
SEL1	7	18	nQ0
SEL2	8	17	GND
PCLK2	9	16	PCLK5
nPCLK2	10	15	nPCLK5
PCLK3	11	14	PCLK4
nPCLK3	12	13	nPCLK4

**ICS854058**  
**24-Lead, 173-MIL TSSOP**  
 4.4mm x 7.8mm x 0.92mm body package  
**G Package**  
 Top View

The Preliminary Information presented herein represents a product in prototyping or pre-production. The noted characteristics are based on initial product characterization. Integrated Circuit Systems, Incorporated (ICS) reserves the right to change any circuitry or specifications without notice.



**TABLE 1. PIN DESCRIPTIONS**

Number	Name	Type		Description
1	PCLK0	Input	Pulldown	Non-inverting differential LVPECL clock input.
2	nPCLK0	Input	Pullup/Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
3	PCLK1	Input	Pulldown	Non-inverting differential LVPECL clock input.
4	nPCLK1	Input	Pullup/Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
5, 20	$V_{DD}$	Power		Positive supply pins.
6, 7, 8	SEL0, SEL1, SEL2	Input	Pulldown	Clock select input pins. LVCMOS/LVTTL interface levels.
9	PCLK2	Input	Pulldown	Non-inverting differential LVPECL clock input.
10	nPCLK2	Input	Pullup/Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
11	PCLK3	Input	Pulldown	Non-inverting differential LVPECL clock input.
12	nPCLK3	Input	Pullup/Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
13	nPCLK4	Input	Pullup/Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
14	PCLK4	Input	Pulldown	Non-inverting differential LVPECL clock input.
15	nPCLK5	Input	Pullup/Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
16	PCLK5	Input	Pulldown	Non-inverting differential LVPECL clock input.
17	GND	Power		Power supply ground.
18, 19	nQ0, Q0	Output		Differential output pair. LVDS interface levels.
21	nPCLK6	Input	Pullup/Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
22	PCLK6	Input	Pulldown	Non-inverting differential LVPECL clock input.
23	nPCLK7	Input	Pullup/Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
24	PCLK7	Input	Pulldown	Non-inverting differential LVPECL clock input.

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
$R_{PULLDOWN}$	Input Pulldown Resistor			75		$K\Omega$
$R_{VDD/2}$	Pullup/Pulldown Resistors			50		$K\Omega$

**TABLE 3. CLOCK INPUT FUNCTION TABLE**

Inputs			Outputs	
SEL2	SEL1	SEL0	Q0	nQ0
0	0	0	PCLK0	nPCLK0
0	0	1	PCLK1	nPCLK1
0	1	0	PCLK2	nPCLK2
0	1	1	PCLK3	nPCLK3
1	0	0	PCLK4	nPCLK4
1	0	1	PCLK5	nPCLK5
1	1	0	PCLK6	nPCLK6
1	1	1	PCLK7	nPCLK7



**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage, $V_{DD}$	4.6V
Inputs, $V_I$	-0.5V to $V_{DD} + 0.5V$
Outputs, $I_O$	
Continuous Current	10mA
Surge Current	15mA
Package Thermal Impedance, $\theta_{JA}$	70°C/W (0 lfpm)
Storage Temperature, $T_{STG}$	-65°C to 150°C

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.

**TABLE 4A. POWER SUPPLY DC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$**

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			68		mA

**TABLE 4B. LVCMOS/LVTTL DC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$V_{IH}$	Input High Voltage	SEL0:SEL2	2		$V_{DD} + 0.3$	V
$V_{IL}$	Input Low Voltage	SEL0:SEL2	-0.3		0.8	V
$I_{IH}$	Input High Current	SEL0:SEL2 $V_{DD} = V_{IN} = 3.465V$			150	$\mu A$
$I_{IL}$	Input Low Current	SEL0:SEL2 $V_{DD} = 3.465V, V_{IN} = 0V$	-10			$\mu A$

**TABLE 4C. LVPECL DC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$I_{IH}$	Input High Current	PCLK0:PCLK7	$V_{DD} = V_{IN} = 3.465V$		150	$\mu A$
		nPCLK0:nPCLK7	$V_{DD} = V_{IN} = 3.465V$		150	$\mu A$
$I_{IL}$	Input Low Current	PCLK0:PCLK7	$V_{DD} = 3.465V, V_{IN} = 0V$	-10		$\mu A$
		nPCLK0:nPCLK7	$V_{DD} = 3.465V, V_{IN} = 0V$	-150		$\mu A$
$V_{PP}$	Peak-to-Peak Input Voltage		0.15			V
$V_{CMR}$	Common Mode Input Voltage; NOTE 1, 2		GND + 1.2			V

NOTE 1: Common mode voltage is defined as  $V_{IH}$ .

NOTE 2: For single ended applications, the maximum input voltage for PCLKx, nPCLKx is  $V_{DD} + 0.3V$ .



**TABLE 4D. LVDS DC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$V_{OD}$	Differential Output Voltage			350		mV
$\Delta V_{OD}$	$V_{OD}$ Magnitude Change			50		mV
$V_{OS}$	Offset Voltage			1.25		V
$\Delta V_{OS}$	$V_{OS}$ Magnitude Change			50		mV

**TABLE 5. AC CHARACTERISTICS,  $V_{DD} = 3.135V$  TO  $3.465V$**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				2.5	GHz
$t_{PD}$	Propagation Delay; NOTE 1			595		ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 2, 3			TBD		ps
$t_R / t_F$	Output Rise/Fall Time	20% to 80%		180		ps

All parameters measured up to 1.3GHz unless noted otherwise.

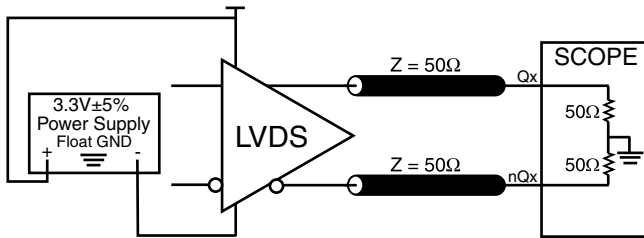
NOTE 1: Measured from the differential input crossing point to the differential output crossing point.

NOTE 2: Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.

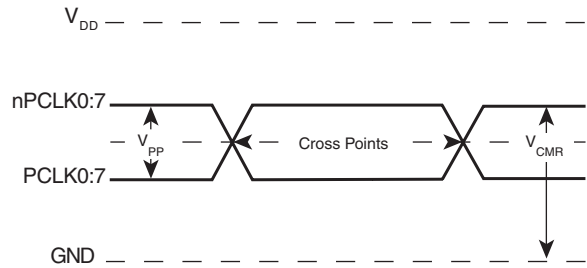
NOTE 3: This parameter is defined according with JEDEC Standard 65.



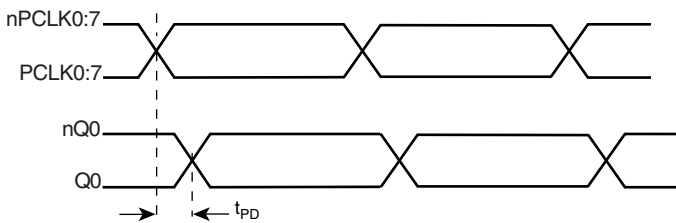
**PARAMETER MEASUREMENT INFORMATION**



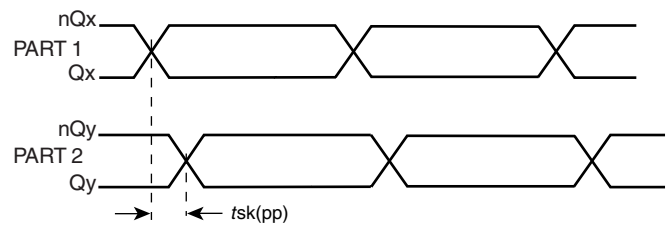
**3.3V OUTPUT LOAD AC TEST CIRCUIT**



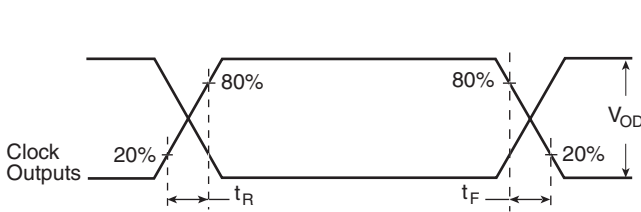
**DIFFERENTIAL INPUT LEVEL**



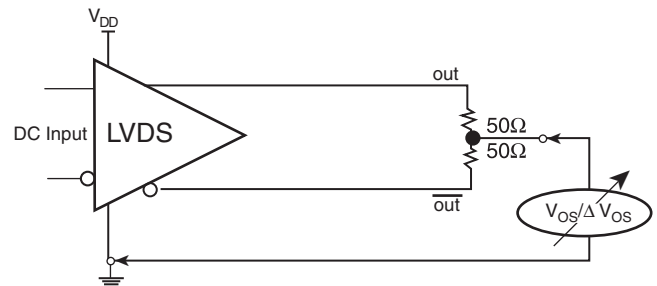
**PROPAGATION DELAY**



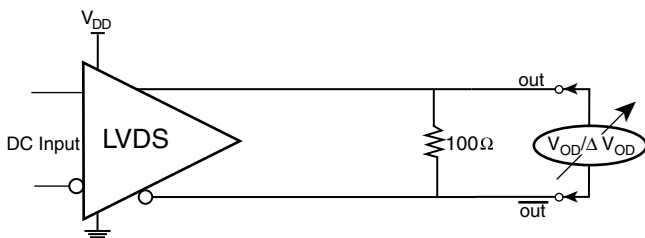
**PART-TO-PART SKEW**



**OUTPUT RISE/FALL TIME**



**OFFSET VOLTAGE**



**DIFFERENTIAL OUTPUT VOLTAGE**

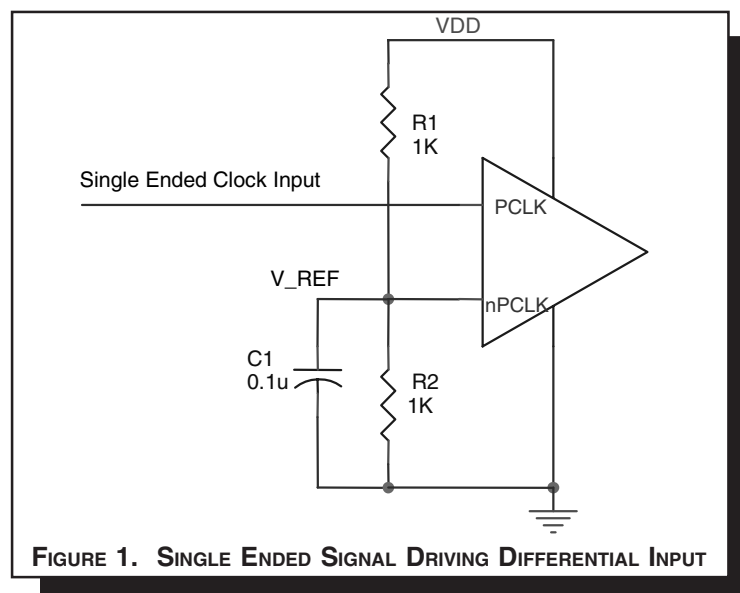


## APPLICATION INFORMATION

### WIRING THE DIFFERENTIAL INPUT TO ACCEPT SINGLE ENDED LEVELS

Figure 1 shows how the differential input can be wired to accept single ended levels. The reference voltage  $V_{REF} = V_{DD}/2$  is generated by the bias resistors R1, R2 and C1. This bias circuit should be located as close as possible to the input pin. The ratio

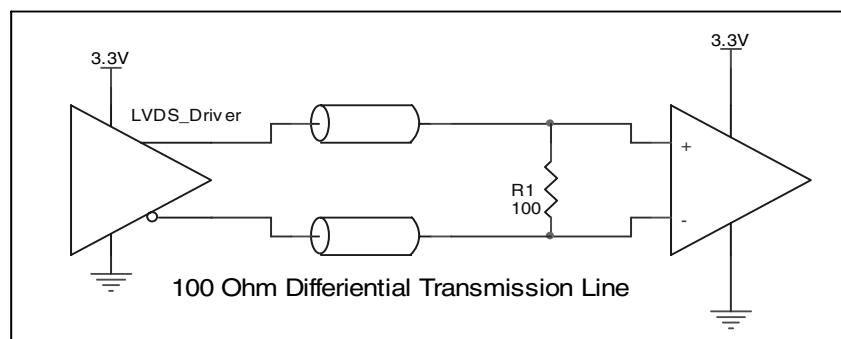
of R1 and R2 might need to be adjusted to position the  $V_{REF}$  in the center of the input voltage swing. For example, if the input clock swing is only 2.5V and  $V_{DD} = 3.3V$ ,  $V_{REF}$  should be 1.25V and  $R2/R1 = 0.609$ .



### LVDS DRIVER TERMINATION

A general LVDS interface is shown in Figure 2. In a 100Ω differential transmission line environment, LVDS drivers require a matched load termination of 100Ω across near the receiver in-

put. For a multiple LVDS outputs buffer, if only partial outputs are used, it is recommended to terminate the un-used outputs.



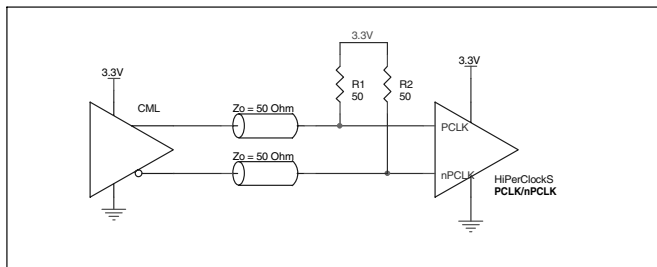




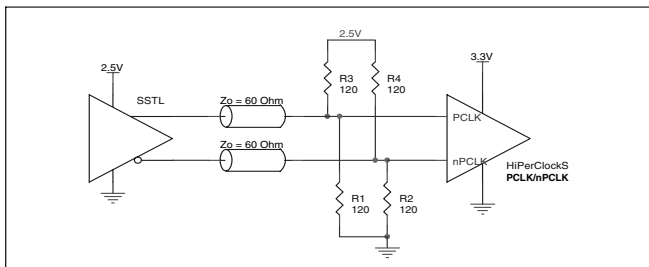
**LVPE CL CLOCK INPUT INTERFACE**

The PCLK /nPCLK accepts LVPECL, CML, SSTL and other differential signals. Both  $V_{SWING}$  and  $V_{OH}$  must meet the  $V_{PP}$  and  $V_{CMR}$  input requirements. Figures 3A to 3E show interface examples for the HiPerClockS PCLK/nPCLK input driven by the most common driver types. The input interfaces sug-

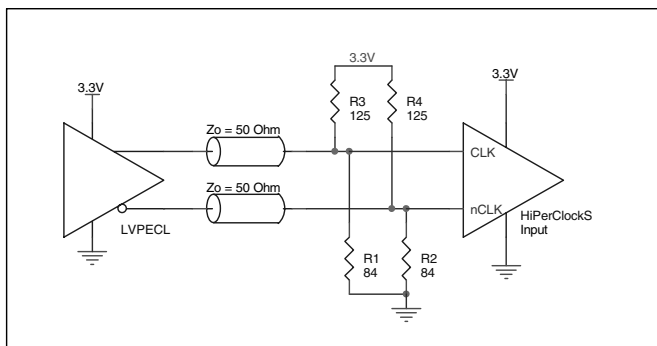
gested here are examples only. If the driver is from another vendor, use their termination recommendation. Please consult with the vendor of the driver component to confirm the driver termination requirements.



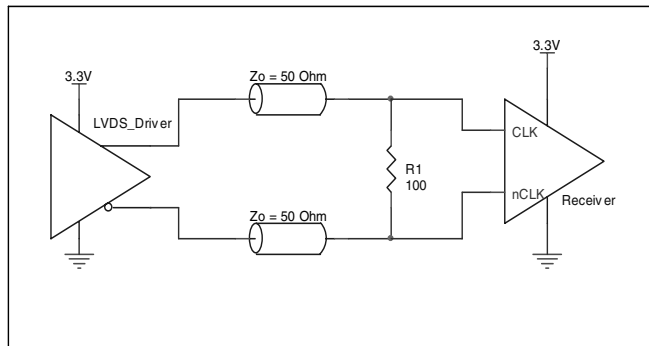
**FIGURE 3A. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A CML DRIVER**



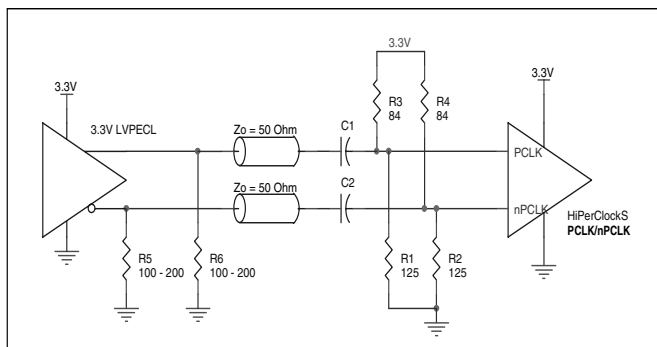
**FIGURE 3B. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY AN SSTL IN DRIVER**



**FIGURE 3C. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVPECL DRIVER**



**FIGURE 3D. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVDS DRIVER**



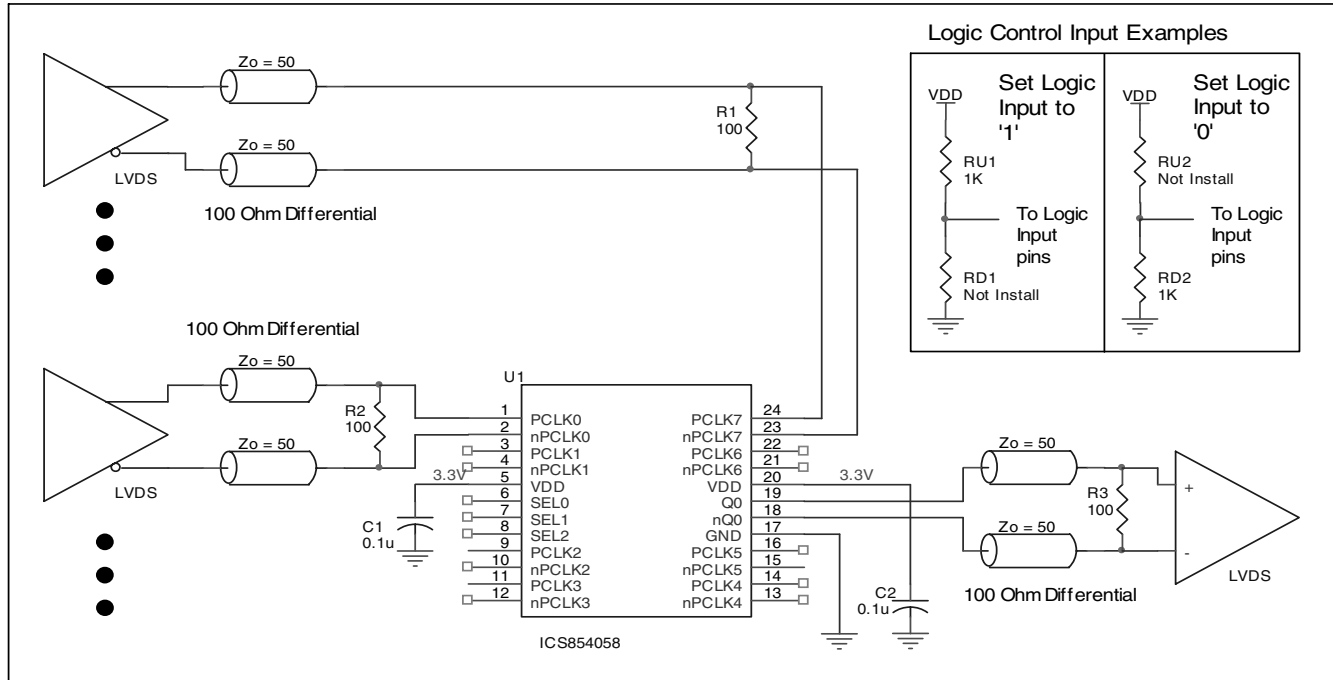
**FIGURE 3E. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVPECL DRIVER WITH AC COUPLE**



**SCHEMATIC EXAMPLE**

An application schematic example of ICS854058 is shown in *Figure 4*. The inputs can accept various types of differential signals. In this example, the inputs are driven by LVDS drivers. The transmission lines are assumed to be 100Ω differential. The 100Ω matched loads termination should be located

near the receivers. It is recommended that at least one decoupling capacitor per power pin. The decoupling capacitor should be low ESR and located as close as possible to the power pin.



**FIGURE 4. ICS854058 SCHEMATIC EXAMPLE**



**RELIABILITY INFORMATION**

**TABLE 6.  $\theta_{JA}$  vs. AIR FLOW TABLE FOR 24 LEAD TSSOP**

<b><math>\theta_{JA}</math> by Velocity (Linear Feet per Minute)</b>			
	<b>0</b>	<b>200</b>	<b>500</b>
Multi-Layer PCB, JEDEC Standard Test Boards	70°C/W	63°C/W	60°C/W

**TRANSISTOR COUNT**

The transistor count for ICS854058 is: 361



PACKAGE OUTLINE - G SUFFIX FOR 24 LEAD TSSOP

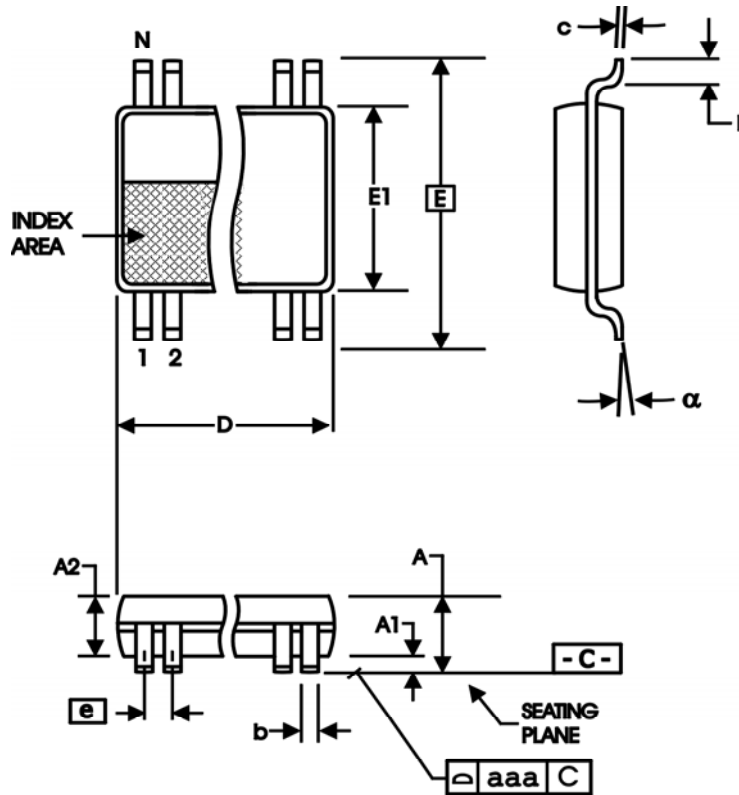


TABLE 7. PACKAGE DIMENSIONS

SYMBOL	Millimeters	
	Minimum	Maximum
N	24	
A	--	1.20
A1	0.05	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
alpha	0°	8°
aaa	--	0.10

Reference Document: JEDEC Publication 95, MS-153



Integrated  
Circuit  
Systems, Inc.

**PRELIMINARY**

**ICS854058**

**8:1**

**DIFFERENTIAL-TO-LVDS CLOCK MULTIPLEXER**

**TABLE 8. ORDERING INFORMATION**

<b>Part/Order Number</b>	<b>Marking</b>	<b>Package</b>	<b>Count</b>	<b>Temperature</b>
854058AG	ICS854058AG	24 Lead TSSOP	60 per tube	-40°C to 85°C
854058AG	ICS854058AG	24 Lead TSSOP on Tape and Reel	2500	-40°C to 85°C

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