



GENERAL DESCRIPTION

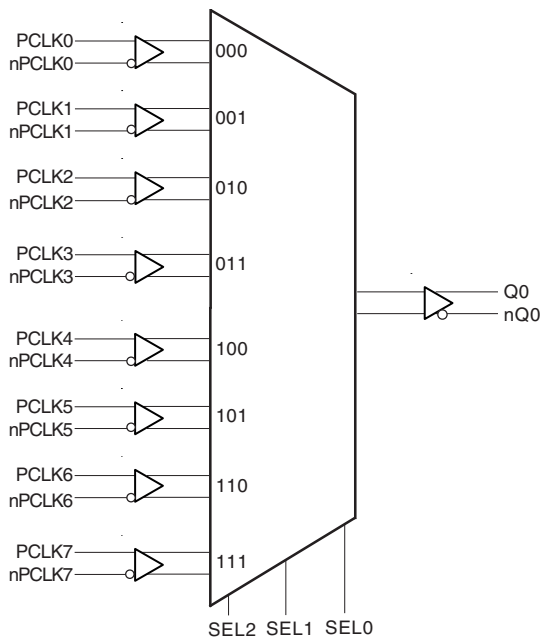


The ICS854058 is an 8:1 Differential-to-LVDS Clock Multiplexer which can operate up to 2.5GHz and is a member of the HiPerClockS™ family of High Performance Clock Solutions from ICS. The ICS854058 has 8 selectable differential clock inputs. The PCLK, nPCLK input pairs can accept LVPECL, LVDS, CML or 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 _{DD} | 5 | 20 | V _{DD} |
| 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, θ_{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 | μA |
| I_{IL} | Input Low Current | SEL0:SEL2 | $V_{DD} = 3.465V, V_{IN} = 0V$ | | -10 | μA |

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 | μA |
| | | nPCLK0:nPCLK7 | $V_{DD} = V_{IN} = 3.465V$ | | 150 | μA |
| I_{IL} | Input Low Current | PCLK0:PCLK7 | $V_{DD} = 3.465V, V_{IN} = 0V$ | | -10 | μA |
| | | nPCLK0:nPCLK7 | $V_{DD} = 3.465V, V_{IN} = 0V$ | | -150 | μA |
| 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 |
| ΔV_{OD} | V_{OD} Magnitude Change | | | 50 | | mV |
| V_{OS} | Offset Voltage | | | 1.25 | | V |
| ΔV_{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.

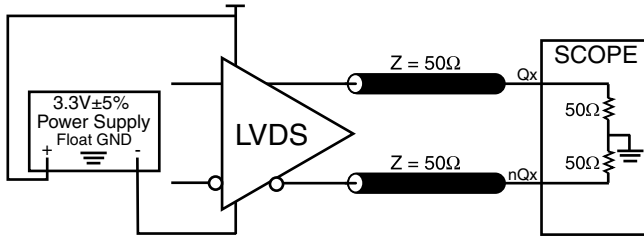
NOTE 1: Measured from the differential input crossing point to the differential output crossing point.

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.

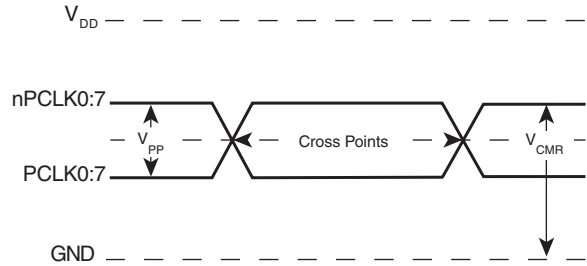
NOTE 3: This parameter is defined according with JEDEC Standard 65.



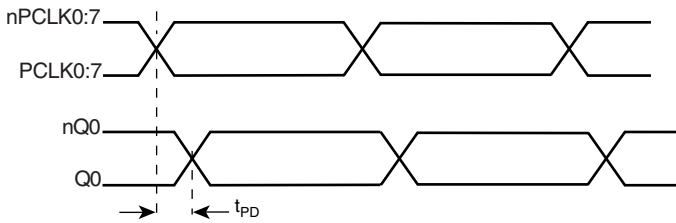
PARAMETER MEASUREMENT INFORMATION



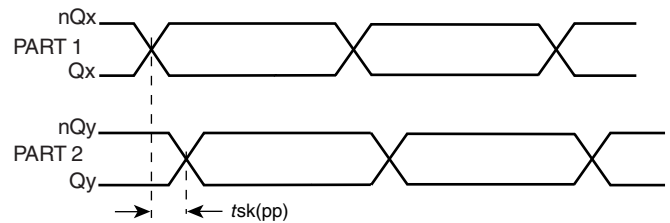
3.3V OUTPUT LOAD AC TEST CIRCUIT



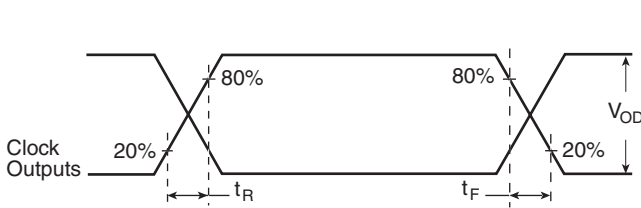
DIFFERENTIAL INPUT LEVEL



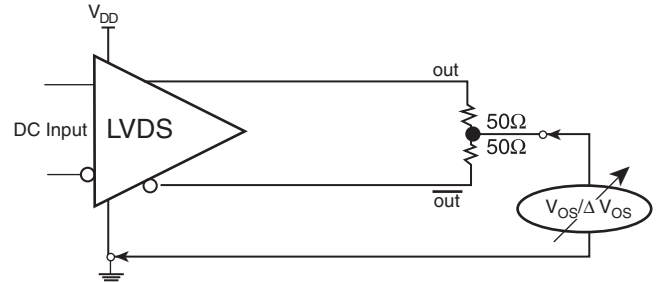
PROPAGATION DELAY



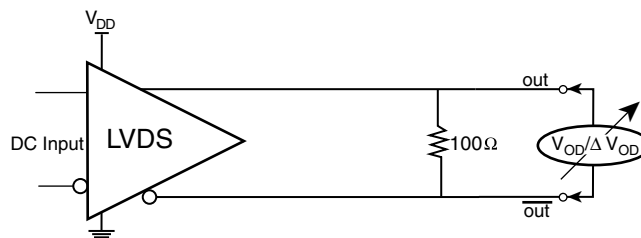
PART-TO-PART SKEW



OUTPUT RISE/FALL TIME



OFFSET VOLTAGE



DIFFERENTIAL OUTPUT VOLTAGE

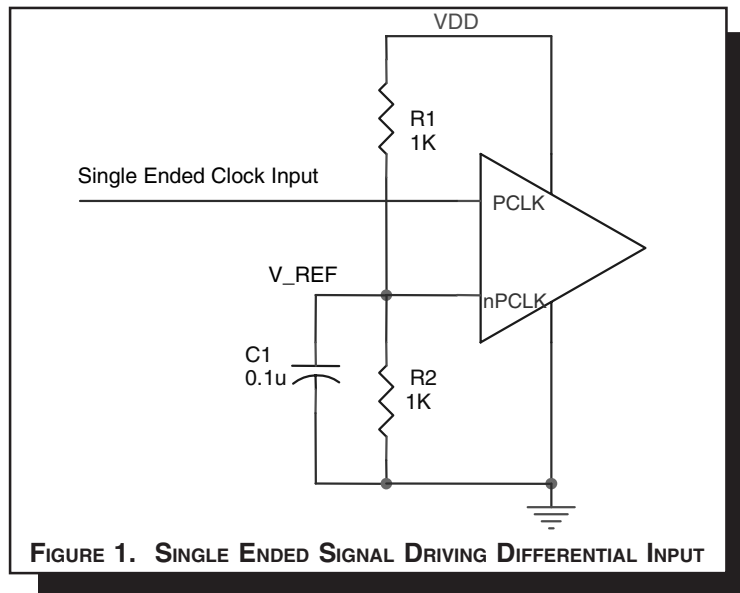


APPLICATION INFORMATION

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

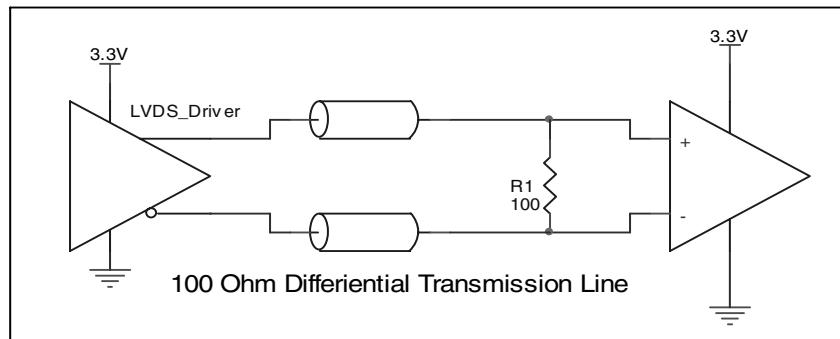
of R1 and R2 might need to be adjusted to position the V_{REF} in the center of the input voltage swing. For example, if the input clock swing is only 2.5V and $V_{DD} = 3.3V$, V_{REF} should be 1.25V and $R2/R1 = 0.609$.



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.

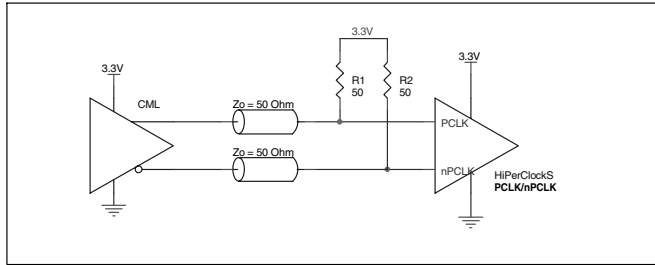


FIGURE 3A. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A CML DRIVER

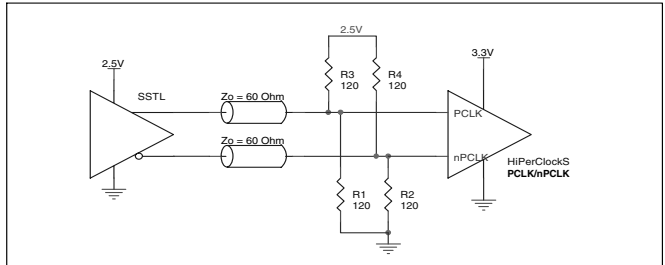


FIGURE 3B. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY AN SSTL IN DRIVER

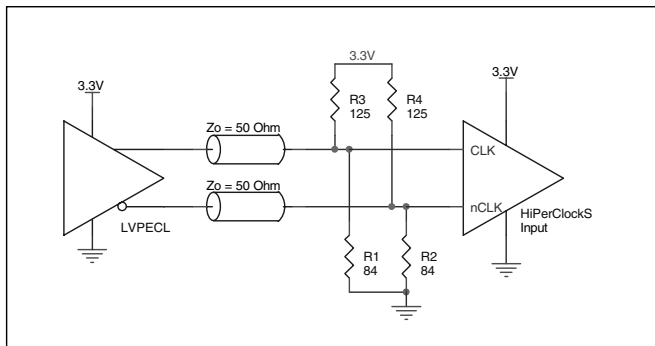


FIGURE 3C. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVPECL DRIVER

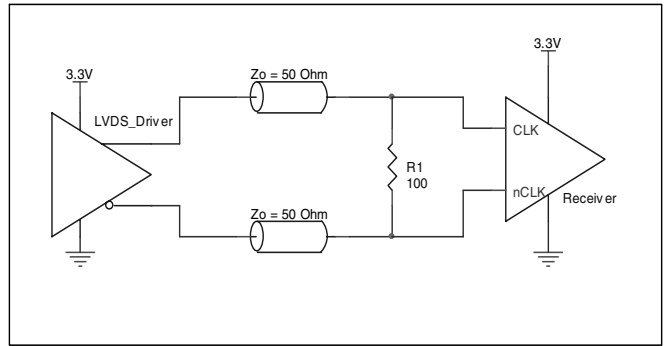


FIGURE 3D. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVDS DRIVER

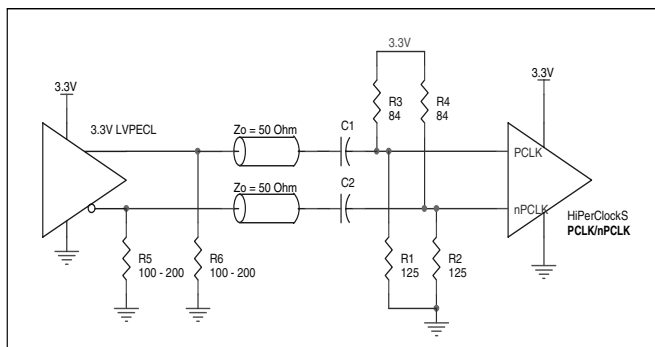


FIGURE 3E. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVPECL DRIVER WITH AC COUPLE



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.

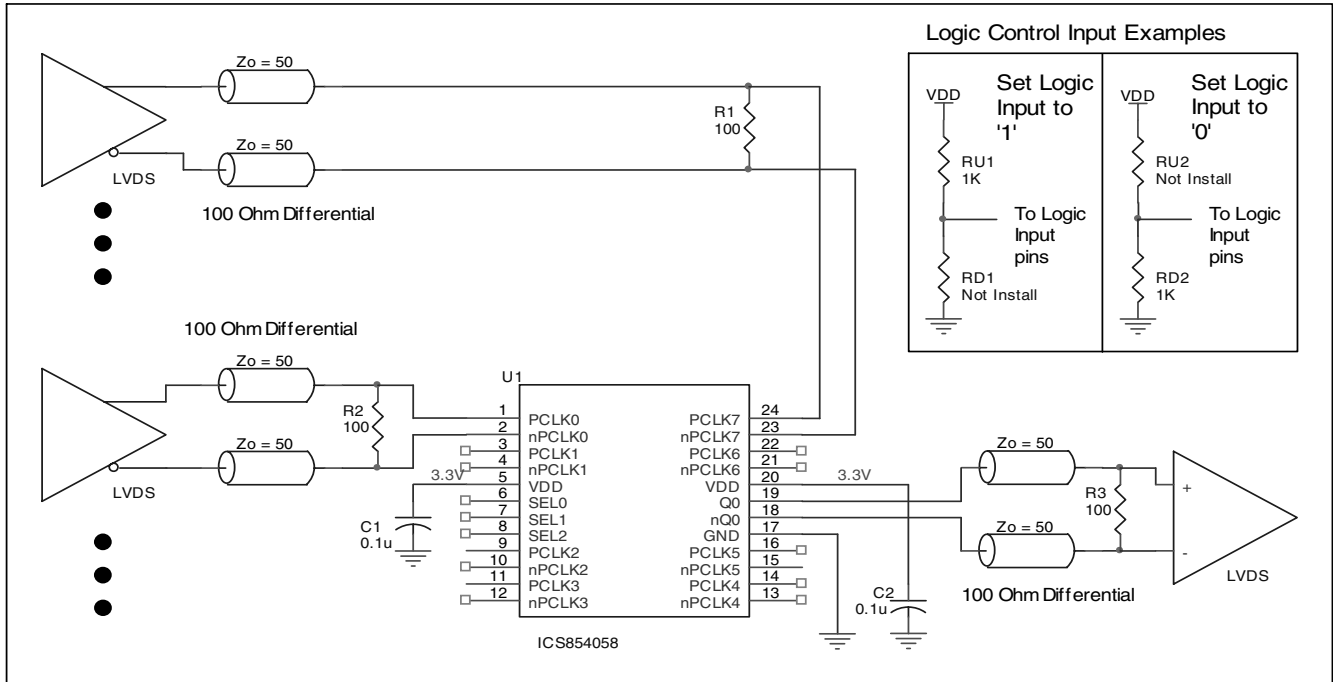


FIGURE 4. ICS854058 SCHEMATIC EXAMPLE



RELIABILITY INFORMATION

TABLE 6. θ_{JA} vs. AIR FLOW TABLE FOR 24 LEAD TSSOP

| θ_{JA} by Velocity (Linear Feet per Minute) | | | |
|--|--------|--------|--------|
| | 0 | 200 | 500 |
| 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

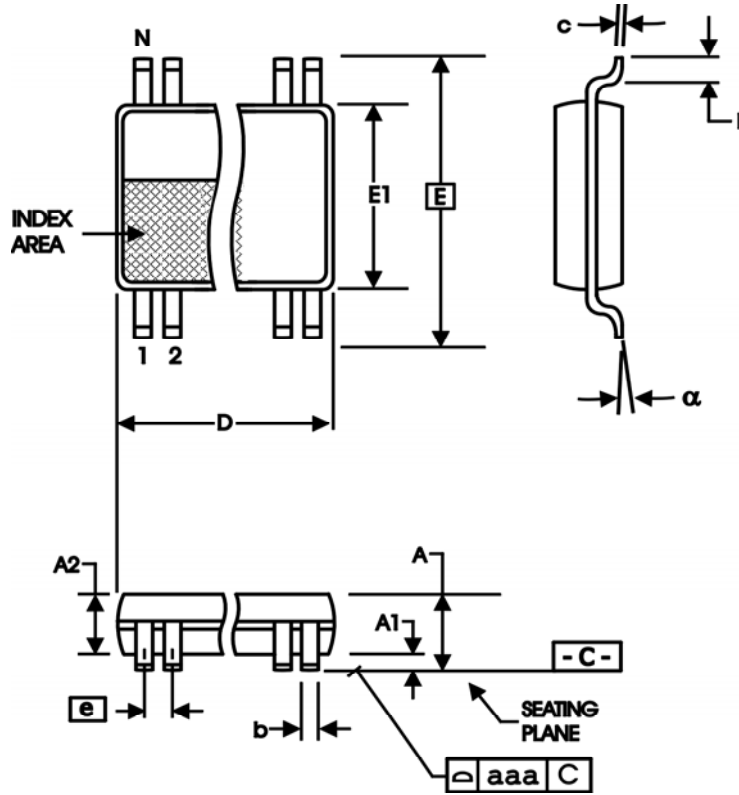


TABLE 7. PACKAGE DIMENSIONS

| 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 |
| α | 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

| Part/Order Number | Marking | Package | Count | Temperature |
|--------------------------|----------------|--------------------------------|--------------|--------------------|
| 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 |

The aforementioned trademark, HiPerClockS™ is a trademark of Integrated Circuit Systems, Inc. or its subsidiaries in the United States and/or other countries.

While the information presented herein has been checked for both accuracy and reliability, Integrated Circuit Systems, Incorporated (ICS) assumes no responsibility for either its use or for infringement of any patents or other rights of third parties, which would result from its use. No other circuits, patents, or licenses are implied. This product is intended for use in normal commercial and industrial applications. Any other applications such as those requiring high reliability, or other extraordinary environmental requirements are not recommended without additional processing by ICS. ICS reserves the right to change any circuitry or specifications without notice. ICS does not authorize or warrant any ICS product for use in life support devices or critical medical instruments.