PRELIMINARY

Integrated Circuit Systems, Inc.

ICS854210
## LOW SKEW, DUAL, 1-TO-5 DIFFERENTIAL-TO-LVDS FANOUT BUFFER

GENERAL DESCRIPTION

The ICS854210 is a low skew, high performance dual 1-to-5 Differential-to-LVDS Fanout Buffer and a member of the HiPerClockS™ family of High Performance Clock Solutions from ICS. The ICS854210 is characterized to operate from a 3.3V power supply. Guaranteed output and part-to-part skew characteristics make the ICS854210 ideal for those clock distribution applications demanding well defined performance and repeatability.

FEATURES

- 2 differential LVDS bank outputs

- 2 differential LVPECL clock input pairs

- PCLKx, nPCLKx pairs can accept the following differential input levels: LVPECL, LVDS, CML, SSTL

- Maximum output frequency: 3.2GHz

- Translates any single ended input signal to LVDS levels with resistor bias on nPCLKx input

- Output skew: TBD

- Part-to-part skew: TBD

- Propagation delay: 280ps (typical)

- 3.3V supply voltage

- -40°C to 85°C ambient operating temperature

BLOCK DIAGRAM
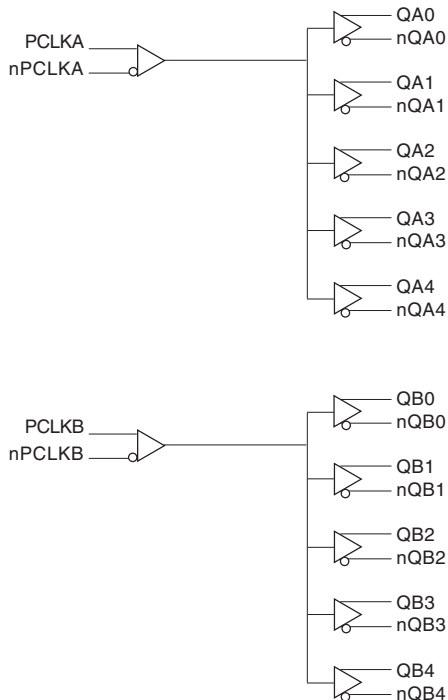
PIN ASSIGNMENT
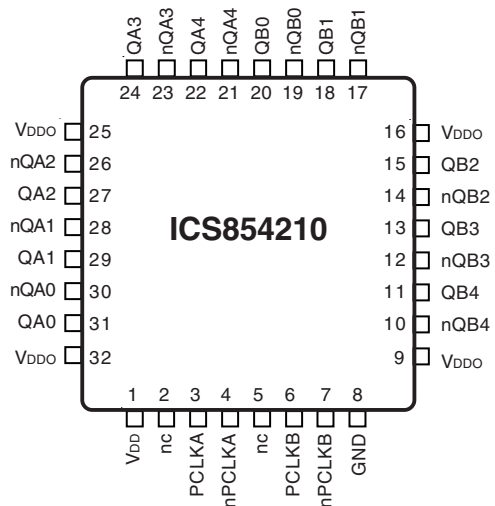
32-Lead LQFP
7mm x 7mm x 1.4mm package body
Y Package
Top View

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TABLE 1. PIN DESCRIPTIONS

Number	Name	Type		Description
1	V_{DD}	Power		Core supply pin.
2, 5	nc	Unused		No connect.
3	PCLKA	Input	Pulldown	Non-inverting differential LVPECL clock input.
4	nPCLKA	Input	Pullup/ Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
6	PCLKB	Input	Pulldown	Non-inverting differential LVPECL clock input.
7	nPCLKB	Input	Pullup/ Pulldown	Inverting differential LVPECL clock input. $V_{DD}/2$ default when left floating.
8	GND	Power		Power supply ground.
9, 25, 32	V_{DDO}	Power		Output supply pins.
10, 11	nQB4, QB4	Output		Differential output pair. LVDS interface levels.
12, 13	nQB3, QB3	Output		Differential output pair. LVDS interface levels.
14, 15	nQB2, QB2	Output		Differential output pair. LVDS interface levels.
17, 18	nQB1, QB1	Output		Differential output pair. LVDS interface levels.
19, 20	nQB0, QB0	Output		Differential output pair. LVDS interface levels.
21, 22	nQA4, QA4	Output		Differential output pair. LVDS interface levels.
23, 24	nQA3, QA3	Output		Differential output pair. LVDS interface levels.
26, 27	nQA2, QA2	Output		Differential output pair. LVDS interface levels.
28, 29	nQA1, QA1	Output		Differential output pair. LVDS interface levels.
30, 31	nQA0, QA0	Output		Differential output pair. LVDS 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
$R_{PULLDOWN}$	Input Pulldown Resistor			75		$k\Omega$
$R_{VDD/2}$	Pullup/Pulldown Resistors			50		$k\Omega$

TABLE 3. CLOCK INPUT FUNCTION TABLE

Inputs		Outputs		Input to Output Mode	Polarity
PCLKA or PCLKB	nPCLKA or nPCLKB	QA0:QA4, QB0:QB4	nQA0:nQA4, nQB0:nQB4		
0	1	LOW	HIGH	Differential to Differential	Non Inverting
1	0	HIGH	LOW	Differential to Differential	Non Inverting
0	Biased; NOTE 1	LOW	HIGH	Single Ended to Differential	Non Inverting
1	Biased; NOTE 1	HIGH	LOW	Single Ended to Differential	Non Inverting
Biased; NOTE 1	0	HIGH	LOW	Single Ended to Differential	Inverting
Biased; NOTE 1	1	LOW	HIGH	Single Ended to Differential	Inverting

NOTE 1: Please refer to the Application Information, "Wiring the Differential Input to Accept Single Ended Levels".

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ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{DD}	4.6V
Negative Supply Voltage, V_{EE}	-4.6V
Inputs, V_I	-0.5V to V_{DD} + 0.5V
Outputs, I_O	
Continuous Current	10mA
Surge Current	15mA
Operating Temperature Range, TA	-40°C to +85°C
Storage Temperature, T_{STG}	-65°C to 150°C
Package Thermal Impedance, θ_{JA} (Junction-to-Ambient)	47.9°C/W (0 lfpm)

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 ± 5%

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Core Supply Voltage		3.135	3.3	3.465	V
V_{DDO}	Output Supply Voltage		3.135	3.3	3.465	V
I_{DD}	Power Supply Current			TBD		mA
I_{DDO}	Output Supply Current			TBD		mA

TABLE 4B. LVPECL DC CHARACTERISTICS, V_{DD} = 3.3V ± 5%

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
I_{IH}	Input High Current	PCLKA, PCLKB	$V_{DD} = V_{IN} = 3.465V$			150	μA
		nPCLKA, nPCLKB	$V_{DD} = V_{IN} = 3.465V$			150	μA
I_{IL}	Input Low Current	PCLKA, PCLKB	$V_{DD} = 3.465V, V_{IN} = 0V$	-150			μA
		nPCLKA, nPCLKB	$V_{DD} = 3.465V, V_{IN} = 0V$	-10			μA
V_{TH}	Differential Input High Threshold Voltage					100	mV
V_{TL}	Differential Input Low Threshold Voltage			-100			mV
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 PCLKA, nPCLKA and PCLKB, nPCLKB is V_{DD} + 0.3V.

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TABLE 4C. LVDS DC CHARACTERISTICS, V_{DD} = 3.3V ± 5%

Symbol	Parameter	-40°C			25°C			85°C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
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

NOTE 1: Refer to Parameter Measurement Information, "3.3V Output Load Test Circuit" diagram.

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

Symbol	Parameter		-40°C			25°C			85°C			Units
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
f_{MAX}	Output Frequency				3.2			3.2			3.2	GHz
t_{PD}	Propagation Delay; NOTE 1			260			280			305		ps
$t$sk(o)	Output Skew; NOTE 2, 4			TBD			TBD			TBD		ps
$t$sk(pp)	Part-to-Part Skew; NOTE 3, 4			TBD			TBD			TBD		ps
t_R/t_F	Output Rise/Fall Time	20% to 80%		175			180			190		ps

NOTE 1: Measured from the differential input crossing point to the differential output crossing point.
NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions.
Measured at the output differential cross points.
NOTE 3: 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.
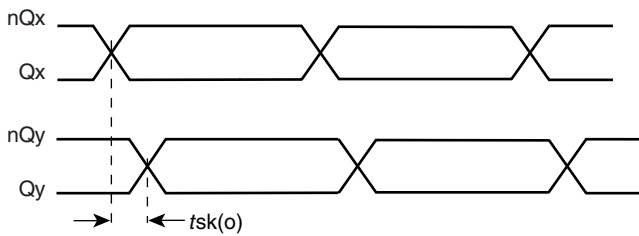NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.
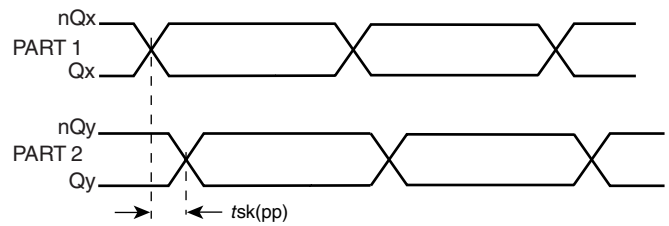
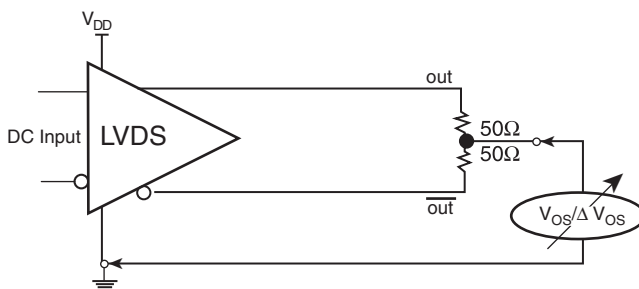## PARAMETER MEASUREMENT INFORMATION
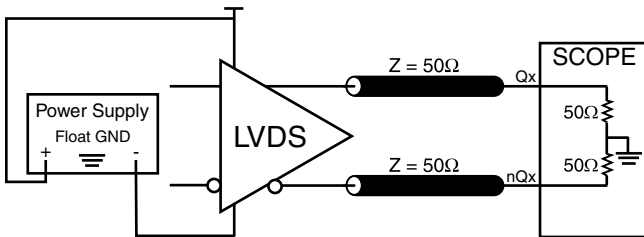
3.3V OUTPUT LOAD AC TEST CIRCUIT
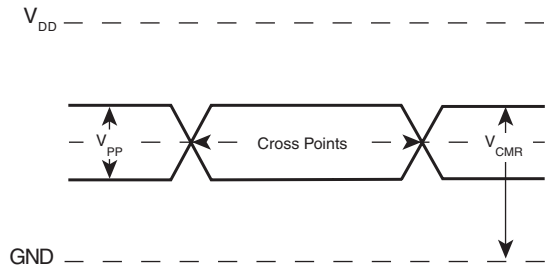
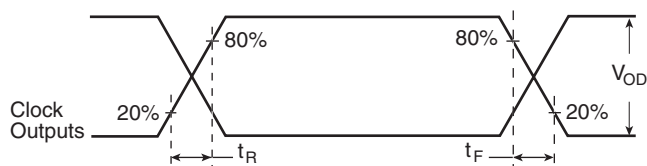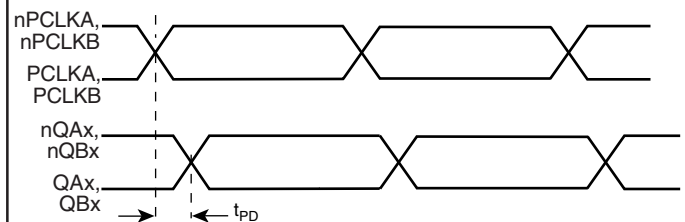
DIFFERENTIAL INPUT LEVEL

OUTPUT SKEW

PART-TO-PART SKEW

V_{OS} SETUP
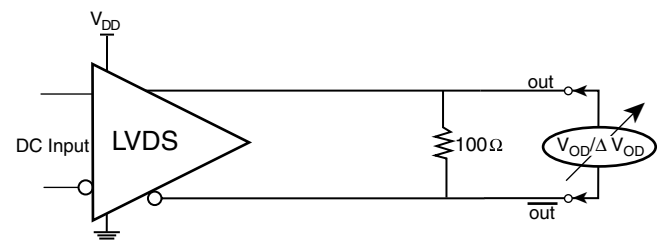
V_{OD} SETUP

OUTPUT RISE/FALL TIME

**PROPAGATION DELAY**

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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.

FIGURE 1. SINGLE ENDED SIGNAL DRIVING DIFFERENTIAL INPUT
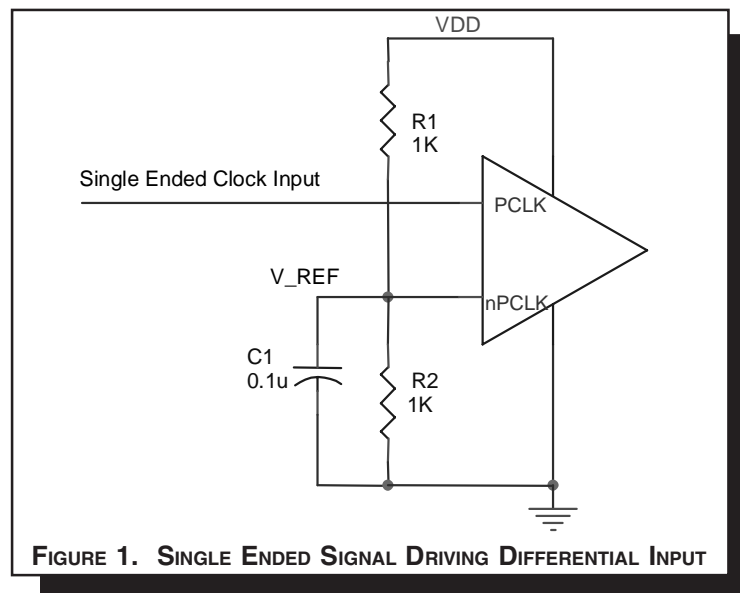
LVDS DRIVER TERMINATION

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

FIGURE 2. TYPICAL LVDS DRIVER TERMINATION

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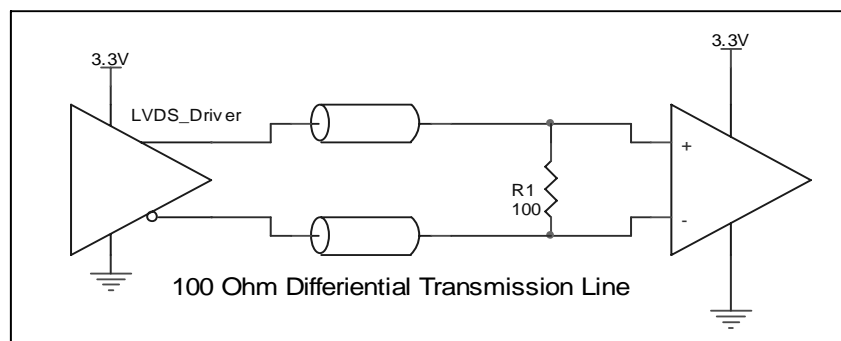
LVPECL CLOCK INPUT INTERFACE

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 3F* show interface examples for the HiPerClockS PCLK/nPCLK input driven by the most common driver types. The input interfaces suggested 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.
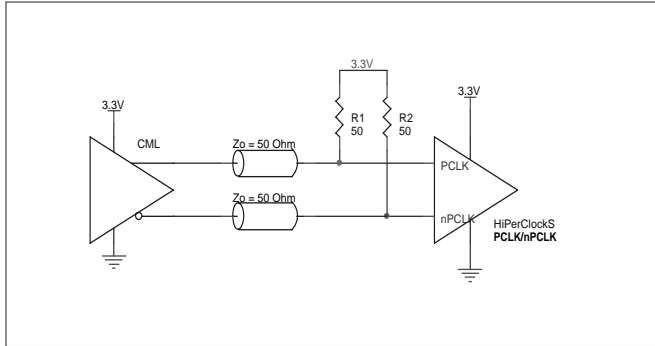
FIGURE 3A. HIPERCLOCKS PCLK/nPCLK INPUT DRIVEN BY AN OPEN COLLECTOR CML DRIVER
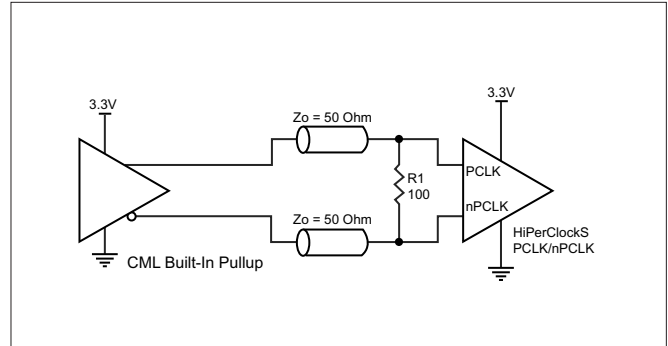
FIGURE 3B. HIPERCLOCKS PCLK/nPCLK INPUT DRIVEN BY A BUILT-IN PULLUP CML DRIVER
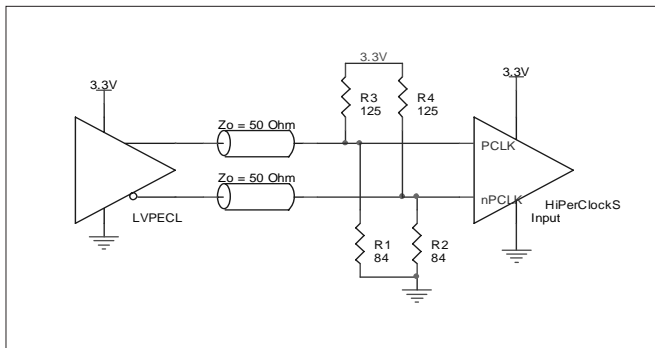
FIGURE 3C. HIPERCLOCKS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVPECL DRIVER
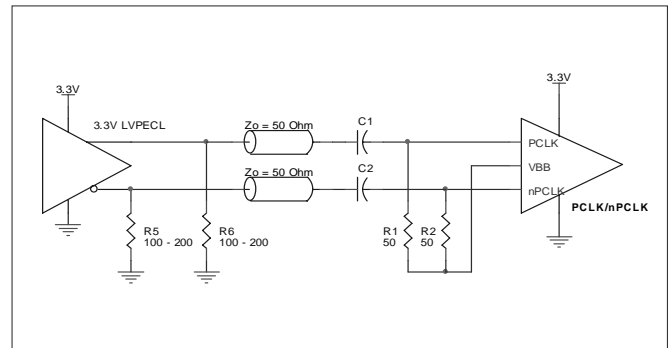

FIGURE 3D. HIPERCLOCKS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVPECL DRIVER WITH AC COUPLE
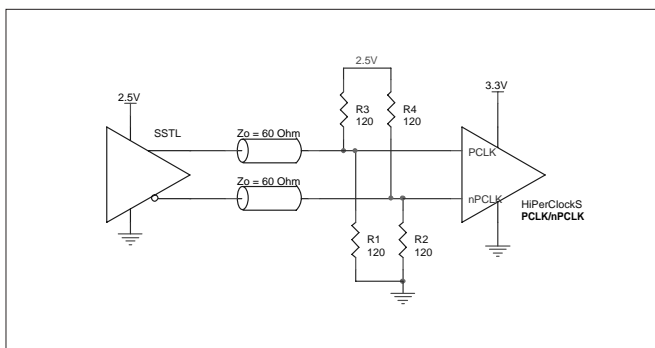

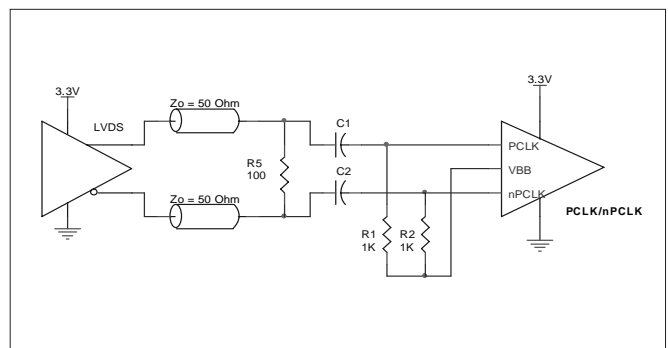**FIGURE 3E.** HIPERCLOCKS PCLK/nPCLK INPUT DRIVEN BY AN SSTL DRIVER

FIGURE 3F. HIPERCLOCKS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVDS DRIVER

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RELIABILITY INFORMATION

TABLE 7. θ_{JA} VS. AIR FLOW TABLE FOR 32L LQFP

θ_{JA} by Velocity (Linear Feet per Minute)			
	0	**200**	**500**
Single-Layer PCB, JEDEC Standard Test Boards	67.8°C/W	55.9°C/W	50.1°C/W
Multi-Layer PCB, JEDEC Standard Test Boards	47.9°C/W	42.1°C/W	39.4°C/W

NOTE: Most modern PCB designs use multi-layered boards. The data in the second row pertains to most designs.

TRANSISTOR COUNT

The transistor count for ICS854210 is: 394

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PACKAGE OUTLINE - Y SUFFIX FOR 32L LQFP
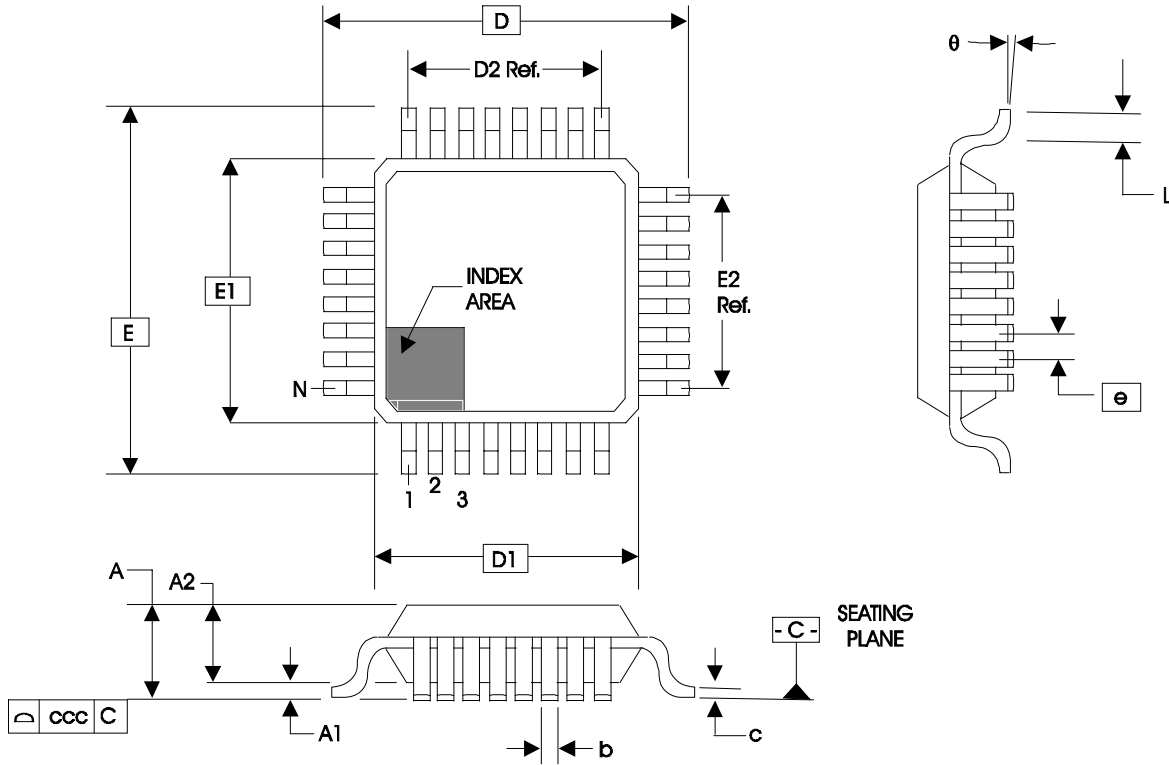
TABLE 8. PACKAGE DIMENSIONS

SYMBOL	JEDEC VARIATION ALL DIMENSIONS IN MILLIMETERS		
	BBA		
	MINIMUM	NOMINAL	MAXIMUM
N	32		
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
b	0.30	0.37	0.45
c	0.09	--	0.20
D	9.00 BASIC		
D1	7.00 BASIC		
D2	5.60 Ref.		
E	9.00 BASIC		
E1	7.00 BASIC		
E2	5.60 Ref.		
e	0.80 BASIC		
L	0.45	0.60	0.75
θ	0°	--	7°
ccc	--	--	0.10

Reference Document: JEDEC Publication 95, MS-026

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TABLE 9. ORDERING INFORMATION

Part/Order Number	Marking	Package	Count	Temperature
ICS854210CY	ICS854210CY	32 lead LQFP	250 per tray	-40°C to 85°C
ICS854210CYT	ICS854210CY	32 lead LQFP on Tape and Reel	1000	-40°C to 85°C